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The physiological and biochemical characteristics of saccharomycetalean yeasts associated endosymbiotically with beetles in the macroscopic fruiting bodies of basidiomycetes

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INTRODUCTION

Although there is a fairly extensive and growing body of literature on fungus and insect interactions, the literature published on fungal endosymbionts is very limited. There is even less literature concerning the yeast and yeast-like fungi associated endosymbiotically with insects. Until recently yeast and yeast-like fungi were known only to be located in the gut of insects in the order Homoptera and of three families of beetles in the order Coleoptera: Anobiidae, Cerambycidae, and Scolytidae; however, the recent discoveries indicate that five out of six beetle families feeding on basidiocarps (polypores, puffballs, etc.) are associated with yeast endosymbionts (Suh et al., unpublished(a)). (The five beetle families are: Nitidulidae, Erotylidae, Tenebrionidae, Ciidae, and Scarabaeidae.) Along with these findings, 95 different yeast specimens, including over 20 new species, have been isolated from these beetles (Suh et al., unpublished(a)). The hypothesis that the yeasts found in the beetle guts are endosymbionts has been extrapolated from other studies and has been indicated by repeated isolation of particular yeasts from the same species of beetle in different localities. The endosymbiotic association is believed to play an important role in insect evolution with the yeast enhancing beetle development and survival.

Previously reported studies on yeast-insect relations support the hypothesis. Endosymbioses has been found to be widespread in insects and are restricted to species with highly specialized nutrition (Jurzitza 1979). Although Starmer (1982) described a *Drosophila*-yeast-plant association which is not endosymbiotic, his findings support this belief as well. He stated that "yeasts and their vectors have coevolved with respect to the chemicals found in their host plants....

Physiological abilities of yeast interact with host plant chemicals to promote the fitness of the insects that serve as dispersal agents for the yeast."

Other studies have described associations of yeasts and beetles. Yeasts found growing endosymbiotically in the guts of anobiid (drugstore and cigarette) beetles were transmitted to the offspring by "contamination of the eggshell" (Jurzitza 1979). Jurzitza (1979) stated that when an egg passed through the ovipositor of the female beetle, its surface was smeared with a secretion containing the symbiont. The hatching larva ate part of the eggshell and became infected with the symbionts (Jurzitza 1979).

Koch (1933a, b; 1934) was the first to succeed in disrupting the symbiosis providing new insight into the yeast-beetle relationship. He did so in the drugstore beetle, *Stegobium paniceum*. He killed the symbionts, which adhered to the eggshell by washing the eggs with a disinfectant. Consequentially, the hatching larvae remained free of yeast endosymbionts. When these aposymbiotic larvae were fed a diet optimal for normal larvae, they were unable to grow. But when Koch added dried yeast or yeast extracts to their diets, the aposymbiotic larvae grew nearly as well as the controls, and aposymbiotic adults resulted. From these results, Koch concluded that the symbionts supply their hosts with nutrients that may have been absent from the beetle's diet. Fraenkel and Blewett were also able to confirm Koch's conclusions under laboratory conditions (1942, 1943a, b).

Becker discussed the possibility that the yeast "might play a role in the nitrogen metabolism of wood-destroying insects" (Jurzitza 1979). Pant, Gupta, and Nayar (1960) confirmed Becker's hypothesis. In comparing the growth of normal and aposymbiotic larvae with diets deficient in amino acids, they found that the aposymbiotic larvae did

not grow when their diets were deficient in one of the nine essential amino acids (Pant et al 1960). However, the normal larvae were able to grow under the latter conditions, although their growth was sometimes retarded (Pant et al 1960). Jurzitza corroborated the need for nitrogen augmentation in the diet of *Lasioderma* larva (1969a, b). The symbionts of this species were able to provide all of the amino acids essential for optimal growth of their host (Jurzitza 1969a, b).

These findings have clearly demonstrated that endosymbiotic yeast associates of beetles play a pivotal role in the growth and development of the insect. None of these studies, however, characterized the yeast found in these beetles or suggested what type of yeast enzymes the beetles might be utilizing. Because these issues are crucial in addressing the role that endosymbionts play in insect evolution, several recent studies have characterized yeast endosymbionts and placed them in a phylogenetic scheme (Jones et al. 1999). Other studies have addressed the issue using methods such as DNA comparisons and assimilation tests (Suh et al., unpublished(a)).

DNA sequencing detects the differences in the variable D1/D2 region of the large domain of the large subunit (26S) ribosomal DNA (rDNA) in yeast (Kurtzman and Robnett 1998). This use of DNA as a means for identification has been used in many studies (Jones and Blackwell 1996, Jones et al. 1999, Suh et al. 2001a, b). Using this method, Kurtzman and Robnett were able to construct a data base of about 600 yeast species, virtually all of the known yeast species. Suh et al. (unpublished(a)) used this method to characterize 95 different yeast specimens that were isolated from beetles. These yeast isolates were grouped according to the host beetle in which they were found and by 70% or greater 26 rDNA complementarity (Kurtzman and Phaff 1987) before they underwent assimilation tests (Table 2). This method of

characterization was used prior to the traditional method of assimilation tests because the results of assimilation tests can be ambiguous due to strain variability (Kurtzman and Robnett 1998).

Assimilation tests are the traditional method used for yeast identification. The term *yeast* has been used to denote unicellular fungi that reproduce by budding. But, it should be noted that the term has no taxonomic meaning and only describes a growth form than may be found in three of the four phyla of fungi (Table 1). "Some zygomycetes, ascomycetes, and basidiomycetes may ... shift from mycelial growth to yeast-like growth under certain environmental conditions" (Alexopoulos et al. 1996). Assimilation tests serve to distinguish taxonomic groups in this growth form and allow the properties, if any, of yeast metabolism that aid beetles to be determined.

Because assimilation tests identify many factors such as ability to utilize a food source and optimum moisture, pH, etc., that influence the growth of fungi (Alexopoulos et al. 1996), they are important in characterizing newly identified yeasts. This information allows closely related yeast strains to be distinguished. This paper will describe 20 morphological characters and 106 biochemical and chemical attributes of 95 isolated yeasts (Suh et al., unpublished(a)), which are believed to be endosymbionts associated with beetles in more than ten families that feed and reproduce in the macroscopic fruiting bodies of basidiomycetes. The significance of assimilation tests performed was described by Yarrow (1998):

- *Carbohydrate fermentation tests* were used to distinguish the ability of yeast species to ferment sugars by measuring their production of carbon dioxide.

- *Carbon compound assimilation tests* were used to test the ability of a yeast isolate to grow by using a supplied carbon compound as the sole source of energy.
- *Formation of extracellular amyloid compounds* helped to identify those species that form extracellular starch-like polysaccharides.
- *Growth at 37 C and at other temperatures* aided in distinguishing yeasts from that may require higher than usual temperatures for growth. Temperatures tested ranged from 25-40 C.
- *Nitrogen compounds assimilation tests* distinguished yeasts by their differing abilities to utilize compounds, such as nitrate, L-lysine, and creatinine, as a sole source of nitrogen.
- *Vitamin requirement tests* distinguished yeasts by requirements for an exogenous supply of certain vitamins. The yeasts were grown in the absence of one of 8 vitamins or without any of vitamins.
- *Growth at high osmotic pressures* identified yeasts that were able to grow in media with high concentrations of sugar or salt.
- *Acetic acid production from glucose* distinguished some yeast based on the production of large amounts of acetic acid.
- *Urea hydrolysis* was used to distinguish ascomycetous yeasts from other phyla. Hydrolysis of urea is not performed by ascomycetes.
- *Cycloheximide resistance* differentiated yeasts that vary in their sensitivity to the antibiotic cycloheximide.
- *Gelatin liquefaction* identified proteolytic yeasts.

- The *diazonium blue B test* distinguished basidiomycetous yeasts, which give a positive response.

MATERIALS AND METHODS

The 95 yeast isolates used in the morphological and assimilation tests were obtained from beetles found in different localities of Louisiana and Georgia (Table 2). Yeasts were isolated from beetle guts using methods described in Suh et al. (unpublished(b)) and were grouped by the similarity of the D1/D2 region of their 26S rDNA (Table 2). Yeasts in the same group have an identical D1/D2 sequence, which is approximately 600 base pairs.

Yeast isolated from beetle guts were numbered in a manner which indicated the date of collection, the locality in which the beetle was found, the number of beetles collected in that locality, and the number of yeast species isolated from the beetle (Table 2). The first three digits indicate the year, month, and day of beetle collection, respectively (Table 2). The fourth digit indicates the numerical order in which the locality was visited on that collection day (Table 2). Beetles found in a locality were numbered consecutively; this is indicated by the fifth number (Table 2). If there is a sixth number, it is the number assigned to more than one yeast strain isolated from a particular beetle gut (Table 2). It should be noted that the letters that may precede the isolate number indicate where in the beetle the yeast was found. For example, "BG" stands for "beetle gut."

It should be noted that most of the techniques used for characterizing the yeast isolates were performed directly as described or were modifications of protocols in Yarrow (1998). More detailed information was provided in an unpublished manual (Suh et al., unpublished(b)).

Morphology of Vegetative Cells

1) Growth in Liquid Media.

Cells from an actively growing culture were inoculated into 5 mL of Yeast Malt broth (YM broth: 0.3% yeast extract, 0.3% malt extract, 0.5% bactopeptone, 1% glucose) in a 16 x 125 mm capped test tube and incubated 7-10 days at 25 C. As described by Yarrow (1998), the culture was observed under a light microscope for vegetative cell shape, size (determined by using the length and width of at least 10 individual cells), method of reproduction, and amount of cell aggregation (single, pairs, clusters, etc.). The culture was also examined for the presence of true hyphae or pseudohyphae.

2) Growth on Solid Media.

Cells from an actively growing culture were inoculated onto a YM agar (0.3% yeast extract, 0.3% malt extract, 0.5% bactopeptone, 1% glucose, 2% agar) plate and a cornmeal agar plate. Cells were distributed in one line down the center of the plate and in 2 spots on either side of the line. In addition to inoculation on the corn meal agar plate, a sterile glass coverslip was placed on one of the inoculated areas of the cornmeal agar (17 g of cornmeal agar (Difco) in 1 L of deionized water) plate. Both YM and cornmeal agar plates were sealed incubated at 25 C for 7-10 days.

Five colony characteristics of both cultures were recorded: texture, color, surface appearance, elevation, and margin appearance (Yarrow 1998). The formation of hyphae or pseudohyphae was determined under a microscope by using the glass coverslip on the cornmeal agar plate.

Fermentation of Carbohydrates

Except for raffinose where 4% (w/v) sugar and 1% yeast extract solution was made, solutions of 2% (w/v) sugar and 1% yeast extract

were dispensed in a 6 mL volume into a Durham tube (a 13 x 100 mm tube containing a 6 x 50 mm inverted tube). The sugars used to make the 2% sugar and 1% yeast extract solutions were: D-glucose, D-galactose, maltose, a-methyl-D-glucoside, sucrose, a-a-trehalose, melibiose, lactose, cellobiose, melezitose, inulin, starch, and D-xylose.

Durham tubes containing the test media were inoculated with 0.1 mL of a light suspension of cells. This suspension was made by dispensing yeast cells, which had grown on YM agar for 2-4 days, in distilled water. The inoculated test media were then incubated at 25 C for 3 weeks. Tubes were shaken periodically and examined every 7 days for gas accumulation. The results were recorded as follows:

+, inverted tube filled with gas within 7 days, positive

l, latent gas accumulation in inverted tube after more than 7 days, positive

s, slow gas accumulation in inverted tube after more than 7 days, positive

w, inverted tube not completely filled with gas after more than 7 days, weak

-, no gas accumulation in the inverted tube, negative

Assimilation Test of Carbon Compounds

47 carbon compounds were used as substrates for each yeast species.

Hexoses: D-glucose, D-galactose, L-sorbose;

Disaccharides: cellobiose, lactose, maltose, melibiose, sucrose, a-a-trehalose;

Trisaccharides: melezitose, raffinose;

Polysaccharides: inulin, soluble starch;

Pentoses: D-arabinose, L-arabinose, D-ribose, L-rhamnose, D-xylose;

Alcohols: L-arabinitol, butane-2,3-diol, *meso*-erythritol, ethanol,

galactitol, D-glucitol, glycerol, *myo*-inositol, D-mannitol, methanol, propane-1,2-diol, ribitol, xylitol;

Organic acids: citric acid, D-galactonate, D-galacturonic acid, 2-keto-D-gluconate, 5-keto-D-gluconate, D-glucuronate, DL-lactic acid, saccharic acid, succinic acid, D-gluconic acid, quinic acid;

Glycosides: a-methyl-D-glucoside, salicin;

Other compounds: arbutin, D-glucono-1,5-lactone, D-glucosamine hydrochloride

1) Growth in Liquid Media for Carbon Test Compounds Excluding Inulin, Ethanol, Methanol, Galactitol, 2-keto-D-Gluconate, 5-keto-D-Gluconate, and Soluble Starch.

4.5 mL of sterile water and 0.5 mL of a filter sterilized 10x carbon stock solution (6.7 g yeast nitrogen base and 5.0 g of carbon compound in 100 mL of purified water) were added to a 16 x 125 mm test tube. It should be noted that the pH of the citric acid, DL-lactic acid, and succinic acid 10x stock solutions was adjusted to pH 5. Also note that the negative control consisted of a 10x stock solution containing no carbon compound, and the liquid medium containing the standard amount of the 10x stock solution of glucose was used as the positive control.

Light cell suspensions were made by transferring a yeast isolate growing on a YM agar plate for 2-4 days to sterilized water. 0.1 mL of the cell suspension was dispensed into each test tube of carbon medium. Test tubes were capped and incubated at 25 C for 3 weeks.

Cultures were observed on days 7 and 21 of the 3-week incubation period. The degree of growth was assessed as described by Yarrow (1998). After the culture was mixed in a vortex apparatus, it was

placed against a white card on which 4-5 parallel lines approximately 5mm apart were drawn with a medium tipped marker. "The result [was] scored 3+ if the lines [were] completely obscured; as 2+ if the lines [appeared] as diffuse bands; as 1+ if the lines [were] distinguish- able as such but [had] blurred edges; as negative if the lines [were] distinct and sharp edged" (Yarrow 1998).

These results were then used to determine the final assessment of growth which was recorded as described by Yarrow (1998):

+, positive, a 2+ or 3+ reading after 1 week of incubation

1, latently positive, a 2+ or 3+ reading after 2 weeks of incubation

s, slowly positive, a 2+ or 3+ reading develops slowly over a period exceeding 2 weeks

w, weakly positive, a 1+ reading ending 3 week incubation period

-, negative, no growth over 3 week incubation period

+/w, positive or weak

w/-, weak or negative

Positive cultures were used in the *formation of extracellular amyloid compounds* test.

2) Growth in Liquid Media Containing either Inulin, Soluble Starch, Galactitol, or 2-keto-D-Gluconate as the Tested Carbon Compound.

To a 16 x 125 mm test tube, 5 mL of filter sterilized 1x carbon stock solution (750mg of carbon compound in 150 mL of Base solution (6.7 g yeast nitrogen base/1000 mL of purified water)) were added. The procedure described for the *Growth in Liquid Media for Carbon Test Compounds Excluding Inulin, Ethanol, Methanol, Galactitol, 2-keto-D-Gluconate, 5-keto-D-Gluconate, and Soluble Starch* was then followed from the point of making light cell suspensions.

3) Growth in Liquid Media with Ethanol as the Tested Carbon Compound.

To a 16 x 125 mm test tube, 5 mL of filter sterilized 1x ethanol stock solution (4.5 mL of ethanol in 150 mL of base solution (6.7 g yeast nitrogen base/1000 mL of purified water)) were added. The procedure for the *Growth in Liquid Media for Carbon Test Compounds Excluding Inulin, Ethanol, Methanol, Galactitol, 2-keto-D-Gluconate, 5-keto-D-Gluconate, and Soluble Starch* was then followed from the description of making light cell suspensions.

4) Growth in Liquid Media with 5-keto-D-Gluconate as the Tested Carbon Compound.

5 mL of filter sterilized 1x 5-keto-D-Gluconate stock solution (450 mg of 5-keto-D-Gluconate in 150 mL of base solution (6.7 g yeast nitrogen base/1000 mL of purified water)) were added to a 16 x 125 mm test tube. The tube was then inoculated with a light cell suspension as described in the previous procedures.

5) Growth in Liquid Media with Methanol as the Tested Carbon Compound.

A 16 x 125 mm test tube containing medium was prepared in the same manner as described for the negative control, and 1 drop of filter sterilized methanol was added to the tube. The tube was then inoculated with a light cell suspension as described in the previous procedures.

Formation of Extracellular Amyloid Compounds

Cultures that tested positive for growth (in liquid media containing a carbon compound or on agar plates containing a nitrogen source) were used to test for the formation of starch. One or two drops of Lugol's iodine (1 g of iodine and 2 g of potassium iodide in 300mL of distilled water) were added to the culture. (The culture was then thoroughly mixed by a vortex machine if it was liquid media.) The isolate was

recorded as being positive for the formation of extracellular amyloid compounds if the color of culture turned blue to green upon addition of the iodine.

Growth at 37 C and other temperatures

Liquid medium was prepared and inoculated in same manner as done for the carbon assimilation test of glucose. The test tubes were then incubated at 25, 30, 35, and 37 degrees. The results were recorded in the same manner as in the *Assimilation Tests of Carbon Compounds.*

Assimilation of Nitrogen Compounds

Yeast isolates were grown on YM agar for a 2-4 day period. The actively growing yeasts were then used to prepare a light suspension of cells in 16 x 125 mm test tubes containing 5.0 mL of autoclaved 1x yeast carbon base broth (1.17g yeast carbon base (Difco) in 100 mL of water). The yeasts were starved by incubation for 5-7 days at 25 C. A drop of the incubated suspension was inoculated on agar plates (pH 5.5-6.5) prepared by dissolving 11.7 g of yeast carbon base (Difco) together with the desired nitrogen compound base solution in 100 mL of distilled water. The following amounts of nitrogen compounds were used to make a 30 mM concentration (or 10x stock solution) of each basal solution: 0.30 g of potassium nitrate, 0.21 g of sodium nitrite, 0.25 g of ethylamine - HCl, 0.66 g of L-Lysine HCl, 0.53 g of cadaverine-HCl, 0.39 g of creatine, 0.34 g of creatinine, 0.65 g of D-glucosamine, 0.20 g of imidazole, 0.61 g of D-tryptophan, and 0.40 g of ammonium sulfate (positive control). These 10x stock solutions were filter sterilized before a 0.1 volume of the solution was added to a 2% autoclaved agar solution. The combined solutions were then poured into Petri dishes.

Note that the negative control plates were prepared as described for the previous nitrogen sources except nitrogen source was omitted.

Inoculated nitrogen plates were incubated for 2 weeks. Plates were observed on days 3, 7, and 14 of the incubation period. Colony growth on the plate containing a nitrogen source was compared to colony growth on the negative and positive control plates. Growing colonies were recorded as "+" while non-growing colonies were recorded as "-."

After the *assimilation of nitrogen compounds* the plates were used for the *Formation of Extracellular Amyloid Compounds* test.

Test for Vitamin Requirement

Yeast isolates were grown on YM agar for 2-4 days. Actively growing yeasts were used to prepare a light suspension of cells in 16 x 125 mm test tubes containing 5.0 mL of autoclaved 1X vitamin free base medium (16.7 g vitamin free yeast base (Difco) in 1000 mL of water). The suspensions were incubated for 5-7 days at 25 C. A drop of the incubated suspension was then used to inoculate 11 test tubes (16 x 125 mm) containing mixtures of different vitamin basal solutions (Table 3).

The vitamin basal solutions were prepared as follows:

Biotin	-	5 mg in 100mL of 50% ethanol
Ca-Panthothenate	-	10 mg in 100mL of 50% ethanol
Folic acid	-	10 mg in 100mL of 20% ethanol
Inositol	-	200 mg in 100 mL H20
Niacin	-	10 mg in 100mL of 50% ethanol
PABA	-	2 mg in 100mL of 0.04N acetic acid
Pyridoxine-HCl	-	2 mg in 100mL of 0.04N acetic acid
Riboflavin	-	4 mg in 100mL of 0.04N acetic acid

Thiamin-HCl - 2 mg in 100mL of 0.04N acetic acid

Table 3. Each tube contained a mixture of vitamin basal solutions as described below. Note: Tube 1 contained only 1x vitamin free base

Vitamin Basal Solution	mL to add to tubes	Tube 1	Tube 2	Tube 3	Tube 4	Tube 5	Tube 6	Tube 7	Tube 8	Tube 9	Tube 10	Tube 11
Biotin	0.6		+	+		+		+	+	+	+	+
Ca-Panthothenate	30		+		+	+	+	+	+	+	+	+
Folic acid	0.03		+	+	+	+	+	+	+	+	+	+
Inositol	1.5			+	+	+	+	+	+	+	+	+
Niacin	6		+	+	+	+	+	+	+		+	+
PABA	15		+	+	+	+	+	+	+	+		+
Pyridoxine-HCl	30		+	+	+	+	+			+	+	+
Riboflavin	7.5		+	+	+	+	+	+	+	+	+	+
Thiamin-HCl	30		+	+	+			+		+	+	+
Water Added to Tubes			31.5	60	31	60	61	60	90	36	45	30

\+ denotes that vitamin basal solution was added

denotes that vitamin basal solution was omitted

Tubes were incubated at 25 C for two weeks and observed on days 3, 7, and 14 of the incubation period. Results were recorded in the same manner as for *Assimilation Tests of Carbon Compounds.*

Growth in Media of High Osmotic Pressure

Yeast isolates to be analyzed were grown on YM agar for 2-4 days. The actively growing yeasts were then used to inoculate 50% glucose-agar (50 g of glucose and 2 g of agar in 100 mL of 1% yeast extract) and 60% glucose-agar (60 g of glucose and 2 g of agar in 100 mL of %1 yeast extract solution) in Petri dishes. Actively growing yeasts were also used to inoculate 5% sodium chloride(NaCl)-5% glucose agar (1 g of

glucose, 5 g of NaCl, and 2 g of agar in 100 mL of distilled water), 10% sodium chloride-5% glucose agar (1 g of glucose, 10 g of NaCl, 2 g of agar in 100 mL of distilled water), and 16% sodium chloride-5% glucose agar (1 g of glucose, 16 g of NaCl, 2 g of agar in 100 mL of distilled water). The positive control was 1% glucose medium (1 g glucose and 2g agar in 100 mL of distilled water). All agar-containing solutions were autoclaved before being poured into Petri dishes. Plates were incubated at 25 C and were observed for colony growth once a week for up to 3 weeks.

Tolerance of 1% Acetic Acid

1% acetic acid medium was made by dissolving 10 g of glucose, 1 g of tryptone, 1 g of yeast extract, and 2 g of agar in 100 mL of distilled water before autoclaving. After the temperature of the solution had cooled to 55-65 C, 1 mL of glacial acetic acid was added. The solution was poured into Petri dishes (100 x 15 mm). 4 different yeast isolates were inoculated on one plate equidistantly from each other. (This was done by drawing two perpendicular lines on the underside of the Petri dish and inoculating one isolate in each of the four divisions). Plates were incubated at 25 C and observed on days 3 and 6 of the incubation period. A well formed colony was recorded as "+," and no growth as "-."

Hydrolysis of Urea

Test medium was prepared by dissolving 38.7 g of Difco urea broth in 1000 ml of distilled water. The solution was filter sterilized, and then aseptically dispensed in 3mL amounts into autoclaved empty test tubes. A loopful a of cells from 2-3 day old cultures was suspended in the broth and incubated at 37 C. The suspensions were checked every 30

min up to 2 hrs for a red color change. Four hours after inoculation, the suspensions were checked again. If a red color was observed a "+" was recorded, and if no color change was observed a "-" was recorded.

Cycloheximide Resistance

Actively growing yeasts were inoculated into liquid media that was prepared in the same manner as described for the carbon assimilation test of glucose. Cycloheximide was then added to media to give final concentrations of 0.01% and 0.1% (w/v). The incubation period and manner of recording results were also performed as described in the same as in the *Assimilation Test of Carbon Compounds*.

Gelatin Liquefaction

Medium containing 10% gelatin was prepared by dissolving 100 g of gelatin, 5 g of glucose, and 6.7 g of yeast nitrogen base in 1000 mL of distilled water. After the mixture was autoclaved, it was poured in 100 x 15 mm Petri dishes. 4 different yeast isolates were inoculated on one plate as described in the *Tolerance of 1% Acetic Acid* test. The inoculated plates were observed for liquefaction once a week for up to 3 weeks. Strong liquefaction was recorded as "+," weak liquefaction as "+/w," and no liquefaction as "-."

Diazonium Blue B (DBB) color reaction

Yeast isolates were grown on YM agar for 3 weeks at 25 C. At room temperature, a few drops of chilled DBB reagent (15 mg of Diazonium Blue B in 15 mL of cold 0.25M tris hydroxymethyl aminomethane buffer, pH 7.0) were dispensed onto the surface of the colony. The test was recorded as positive if a dark red color developed within a few minutes of the addition of DBB.

RESULTS

Of 98 yeasts isolated from the guts of beetles, all except three could be cultured on media for subsequent use in assimilation tests (Fig. 1, 2; Table 2). (Those yeast isolates which were not cultured are omitted from the Table 2 and Tables 4-17, detailing the results of the performed assimilation tests.) As expected, the isolates grouped by their 26S rDNA exhibit a significant number of affinities for substrates.

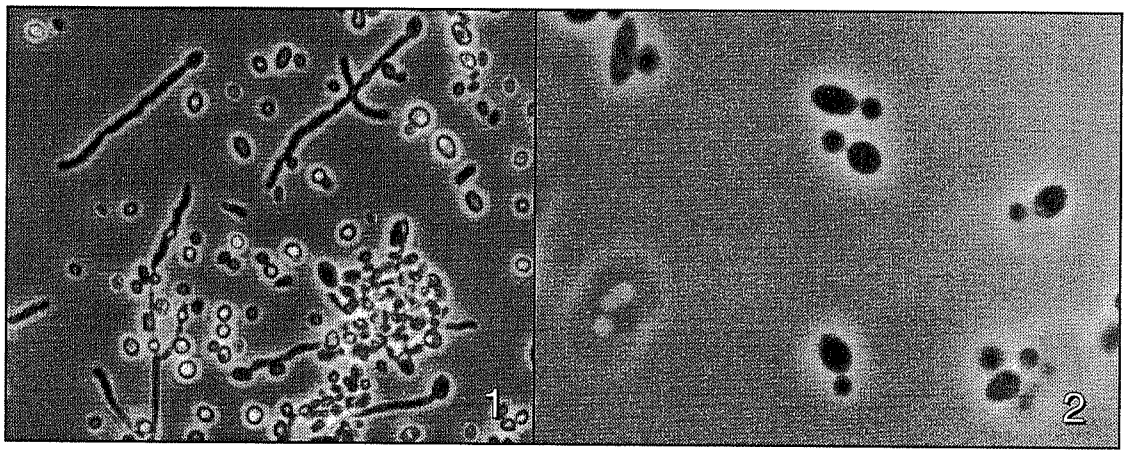

Fig. 1-2. Yeasts from pure culture. 1. Yeast producing pseudohyphae. 2. Budding yeast cells. Mature cells are approximately 5µm in diameter.

Growth of yeast isolates in YM broth yielded data consistent with the characteristics previously reported for other yeasts (Table 4A) (Yarrow 1998). Cell size, shape, and mode of reproduction (budding or fission) were some of the yeast characteristics recorded in this test (Table 2A). The other morphological tests, growth on YM agar and growth on cornmeal agar, also yielded results that were expected based on previously described yeast growth on this media (Tables 4B & 4C) (Yarrow 1998).

Results of the *carbohydrates fermentation tests* and the *carbon compounds assimilation tests* clearly showed that yeast isolates grouped

by similarity of their D1/D2 region of their 26S rDNA exhibited many of the same affinities for substrates (Tables 5 & 6). Some substrates, such as lactose and starch, were not fermented by any of the isolates (Table 5). As described by Yarrow (1998), yeast isolates that ferment a particular carbohydrate substrate are also able to grow aerobically in liquid media containing that carbohydrate (Tables 5 & 6). However, the reverse did not hold true because a number of yeast isolates that were able to grow aerobically in sugars were not able to ferment them, for example, the C1 groups in lactose (Tables 5 & 6).

Most of the yeast strains grew best at temperatures between and including 25 and 30 C (Table 8). Yet, there were strains, such as the E1, N1, and N2 grouped isolates, that were able to grow well at temperatures as high as 40 C (Table 8).

In addition to having certain optimal growth temperatures, yeasts have also been reported to utilize a wide variety of nitrogen sources as their sole source of energy (Yarrow 1998). Only the C1 group was able to grow on nitrate and nitrite (Table 9). Few isolates were able to utilize imidazole or tryptophan as their sole nitrogen sources (Table 9). However, nearly all strains were able to utilize ethylamine, lysine, and cadaverine as their sole nitrogen source (Table 9). It should also be noted that yeasts that utilized creatine as their sole nitrogen source, always metabolized creatinine as well (Table 9).

Yeast growth in liquid media devoid of either all or one or a pair of vitamins also provided information for yeast characterization. Only a T6 isolate grew in media devoid of all vitamins (Table 10). However, all 95 strains were able to grow without utilizing myo-inositol, panthothenate, niacin, and PABA (Table 10). Strains that required biotin for growth did not require thiamin for growth, and the

converse was found true also (Table 10). All isolates except the E10 and T6 groups were able to grow in the absence of pyridoxine, and only those isolates that required thiamin could grow in the absence of both thiamin and pyridoxine (Table 10).

The ability of the yeast isolates to grow under high osmotic conditions induced by sugar concentration was tested by growth on agar media containing 50% and 60% glucose. Growth of the isolates on 50% glucose-agar was retarded for almost half of the isolates, with yeast in the same 26 rDNA group showing the same affinity for growth on this media (Table 11). Growth of all isolates was retarded on 60% glucose-agar compared to growth on 50% glucose-agar (Table 11).

The ability of the yeast isolates to grow at high concentrations of salt was tested by growth on 5% glucose-agar containing 5%, 10%, and 16% NaCl. All strains were able to grow well on 5% NaCl media with the exception of the T2, T3, D1, and D2 groups (Table 11). Yeast growth was retarded in approximately 15% of the isolates as the concentration of NaCl in the media increased from 5% to 10% (Table 11). At 16% NaCl concentration, only E5 and N2 groups of isolates were able to grow unimpeded by the NaCl concentration of the agar (Table 11).

Yeast isolates could also be differentiated by their sensitivity to the antibiotic cycloheximide. Generally groups, like T1, and isolates from certain beetle families, such as Ciidae, whose growth was not retarded (not latent or slowly positive) in liquid media of 0.01% cycloheximide had unretarded growth in media of 0.1% cycloheximide (Table 14). Those isolates whose growth was retarded at the 0.01% cycloheximide concentration were generally not able to grow in 0.1% cycloheximide (Table 14).

Results of several assimilation tests produced negative results for all or most yeast isolates. None of the isolates was found to

produce extracellular polysaccharides (Table 7). None was able to produce enough acetic acid for diagnostic value (Table 12), and none was able to liquefy gelatin (Table 15). Only the T2 and T3 groups yielded positive results when a solution of diazonium blue b was applied to their actively growing cultures (Table 15). The T2 and T3 groups were also the only two groups found to hydrolyze urea (Table 13).

Table 1. Characteristics of the Four Phyla of Fungi.

Characersitics	**Phlyla**			
	Chytridiomycota	*Zygomycota*	*Ascomycota*	*Basidiomycota*
Mycelium	typically coenocytic (lacks regular septation) but there are many variants	coenocytic (lacks regular septation)	compartmentalized; dikaryotic; may be organized into fungal tissues	compartmentalized; dikaryotic; may be organized into fungal tissues
Cell wall	composed of chitin glucon	composed of chitin, chitosan, & polyglucuronic acid	composed of two layers: a thick translucent inner layer & a dense thin outer layer; layers are composed of mainly chitin & beta glucans	composed of several interspersed dense & translucent layers
Yeast stages in life cycle?	no	yes	yes	yes
Reproductive phases	sexual & asexual	sexual & asexual	sexual & asexual	sexual & asexual
Mode of sexual reproduction	variety of methods: planogametic copulation, gametangial copulation, or somatogamy	by thick walled resting spores (zygospores), but not all species produce them	by spores (ascospores) produced internally in a sac called an ascus;	by spores (basidiospores) borne externally in a club shaped structure called a basidium;
Mode of asexual reproduction	by zoospores (motile a-sexually produced spores) are borne in spornagia (a sac-like structure whose contents are con-verted into spores)	usually by sporangio-spores but can also occur by conidia, chlamydospres, oidia, arthrospores	may be carried out by fission, fragmentation, or formation of chlamydo-spores, or conidia according to species enviromental conditions	may take place by bud-ding, fragmentation of the mycelium & by the production of conidia, arthrospores, or oidia
Motile cells?	yes, (sexual & asexual motile spores, with posterior flagella)	no	no	no
Manner in which new walls form in budding	-	-	buds have new wall layers that are continuous with the parent wall (hologenous)	buds have a new wall layer that is not continuous with that of the parental cell (enterogenous)
Positive stain-ing rxn to DBB	no	yes	no	yes

Table 2. Yeast Isolates from Beetle Guts Grouped by 26S rDNA Sequences.

Host beetle	Host fungus, locality*	Yeast isolate number	Group
Erotylidae			
Triplax sp.	*Amanita* sp. RLM	98-8-25-1-2	E1
		98-8-25-1-4	E1
		98-8-25-1-5	E1
Triplax sp.	*Amanita* sp. SF	98-9-24-2-1	E1
Triplax sp.	*Amanita* sp. SF	99-6-12-1-1	E2
Megalodacne fasciata	*Ganoderma applanatum*, MP	99-8-11-1-1	E3
		99-8-11-1-2-1	E3
		99-8-11-1-2-3	E3
		99-8-11-1-3	E3
		99-8-11-1-2-2	E4
		99-8-11-1-2-4	E4
unidentified sp.	*unidentified polypore*	00-6-14-1-1	E4
		00-6-14-1-2	E4
		00-6-14-1-3	E4
		00-6-14-2-1	E4
		00-6-14-2-2	E4
		00-6-14-2-3	E4
		99-8-11-1-4-1	E5
		99-8-11-1-4-2	E6
		99-8-11-1-C1	E7
		99-8-11-1-C2	E8
Triplax sp.	*Amanita* sp. GA	99-11-14-10-1-1	E9
		99-11-14-10-2-1	E9
		99-11-14-10-3-1	E9
		99-11-14-10-3-2	E9
		99-11-14-11-1-1	E9
		99-11-14-11-4-1	E9
		99-11-14-11-5-1	E9
		99-11-14-10-4-1	E10
Gibbifer californicus	Coronado Nat. For.	00-8-15-4-1	E12
Tenebrionidae			
Neomida bicornis	*Fomitella supina*, BS	98-8-18-2	T1
Neomida bicornis	*Fomitella supina*, SF	98-12-9-1-1	T1
		98-12-9-1-3	T1
Neomida bicornis	*Fomitella supina*, HA	99-2-5-2-1-1	T1
		99-2-5-2-1-2	T1
		99-2-5-2-2-1	T1
Neomida bicornis	*Fomitella supina*, SF	99-3-22-1-1	T1
		99-3-22-1-2	T1
		99-3-22-1-3	T1
		99-3-22-1-4	T1
Neomida bicornis	*Fomitella supina*, HA	99-9-28-1-4	T1
Neomida bicornis	*Fomitella supina*, RLM	00-6-7-1-1	T1
		00-6-7-1-2	T1
		00-6-7-1-3	T1
Neomida bicornis	*Fomitella supina*, AP	00-6-26-2	T1

Table 2 (continued). Yeast Isolates from Beetle Guts Grouped by 26S rDNA Sequences.

Host beetle	Host fungus, locality*	Yeast isolate number	Group
Neomida bicornis	*Fomitella supina*, SF	98-12-9-1-2	T2
Neomida bicornis	*Fomitella supina*, SF	98-9-24-3-1	T3
		98-9-24-3-2	T3
Platydema sp.	Decayed polypore, DT	98-9-2-2-4	T4
Platydema sp.	*unidentified, AP polypore*	00-6-23-2-1	T4
		00-6-23-2-2	T4
		00-6-26-1-2-1	T4
		00-6-26-1-2-2	T4
		00-6-26-1-2-3	T4
Platydema sp.	*unidentified*, DT *polypore*	00-7-5-1-2-2	T4
		00-7-5-1-3-1	T4
		00-7-5-1-3-2	T4
		00-7-5-1-4-1	T4
		00-7-5-1-4-2	T4
Diaperis nigronotata	*Inonotus ludovicianus*, DT	00-6-23-1-1	T4
		00-6-23-1-2	T4
		00-6-23-1-3	T4
Diaperis nigronotata	*Inonotus ludovicianus*, LSU	99-8-18-1-1	T5
		99-8-18-1-3-1	T6
		99-8-18-1-3-2	T6
		99-8-18-1-6	T6
		99-8-18-1-4-1	T7
		99-8-18-1-4-2	T7
Neomida bicornis	*Fomitella supina*, HA	00-7-5-1-2-1	T9
		00-7-5-1-2-3	T9
		00-6-26-2-2	T10
Bolitotherus cornutus	*Ganoderma* sp., Indian C, BR.VT	00-7-30-1-1	T11
		00-7-30-1-2	T11
		00-7-30-1-C	T11
	Ganoderma sp., MP	00-8-15-1-1	T11
Nitidulidae			
Carpophilus sp.	*Pisolithus tinctorius*, LSU	98-8-14-1-2-1	N1
		98-8-14-1-3-3	N1
		98-8-14-1-4-3	N1
Carpophilus sp.	*Pisolithus tinctorius*, LSU	98-8-14-1-3-1	N2
Carpophilus sp.	*Pisolithus tinctorius*, LSU	98-8-14-1-3-2	N3
		98-8-14-1-4-2	N3
Carpophilus sp.	*Pisolithus tinctorius*, LSU	98-8-14-1-4-1	N4
Ciidae			
cf. *Ceracis curtus*	*Fomitella supina*, SF	98-12-9-2-1	C1
		98-12-9-2-2-1	C1
		98-12-9-2-2-2	C1
cf. *Ceracis curtus*	*Fomitella supina*, HA	99-2-5-7-1-1	C2
		99-2-5-7-1-2	C2
		99-2-5-7-1-3	C2

Table 2 (continued). Yeast Isolates from Beetle Guts Grouped by 26S rDNA Sequences.

Host beetle	Host fungus, locality*	Yeast isolate number	Group
Scarabaeidae			
Unidentified sp.	*Boletus* sp. RLM	98-8-5-1-1	S1
Mycetophagidae			
Unidentified sp. 1		99-11-14-1-4-1	M1
		99-11-14-1-4-2	M2
Derodontidae			
Derodontus esotericus		99-11-14-5-2-1	D1
Derodontus esotericus	*Hericium* sp.	99-11-14-8-2-1	D1
		99-11-14-8-3-1	D1
Derodontus maculatus		99-11-14-7-C	D2

* LSU (Louisiana State University campus, Baton Rouge, LA), RLM (Rural Life Museum, Baton Rouge, LA), HA (Hilltop Arboretum, Baton Rouge, LA), DT (downtown, Baton Rouge, LA), AP (Antioch Park, Baton Rouge, LA), BS (Bluebonnet Swamp, Baton Rouge, LA). SF (St. Francisville, LA; 30mi north of Baton Rouge), MP (Memorial Park, Athens, GA).

Table 4. Morphology of Vegetative Cells.

A. Growth in Yeast Malt (YM) Broth.

Grp	Isolate Number	Characteristics of Cells as Observed under Microscope[a]
E1	BG 98-8-25-1-2	(2.5-5 um)X(2.5-5 um), budding, hyphae, pseudohyphae, globose-ovoid, single, pairs, chains, clusters
E1	BG 98-8-25-1-4	(1.25-3.75 um)X(1.25-3.75 um), budding, hyphae, pseudohyphae, globose-ellipsoid, single, pairs, chains, clusters
E1	BG 98-8-25-1-5	(2.5-3.75 um)X(2.5-3.75 um), budding, hyphae, pseudohyphae, globose-ellipsoid, single, pairs, chains, clusters
E1	BG 98-9-24-2-1	(1.25-2.5 um)X(2.5-3.75 um), budding, hyphae, pseudohyphae, globose-ellipsoid, single, pairs, chains, clusters
E2	BG 99-6-12-1-1	(2.5-3.75 um)X(3.75-5 um), budding, hyphae, pseudohyphae, globose-ellipsoid, single, pairs, chains, clusters
E3	BG 99-8-11-1-1	(3.75-5 um)X(3.75-5 um), budding, hyphae, pseudohyphae, globose-ellipsoid, single, pairs, chains, clusters
E3	BG 99-8-11-1-2-1	(2.5-3.75 um)X(2.5-5 um), budding, No hyphae or pseudohyphae, globose-ellipsoid, single, pairs, chains, clusters
E3	BG 99-8-11-1-2-3	(2.5-3.75 um)X(3.75-5 um), budding, hyphae, pseudohyphae, subglobose-ovoid, single, pairs, chains, clusters
E3	BG 99-8-11-1-3	(2.5-3.75 um)X(2.5-5 um), budding, hyphae, pseudohyphae, globose-ellipsoid, single, pairs, chains, clusters
E4	BG 99-8-11-1-2-2	(2.5-3.75 um)X(3.75-5 um), budding, hyphae, pseudohyphae, globose-ellipsoid, single, pairs, chains, clusters
E4	BG 99-8-11-1-2-4	(2.5-3.75 um)X(2.5-5 um), budding, hyphae, pseudohyphae, globose-ellipsoid, single, pairs, chains, clusters
E4	BG 00-6-14-1-1	(2.5-3.75 um)X(2.5-5 um), budding, hyphae, pseudohyphae, globose-ellipsoid, single, pairs, chains, clusters
E4	BG 00-6-14-1-2	(2.5-3.75 um)X(2.5-5 um), budding, hyphae, pseudohyphae, globose-ellipsoid, single, pairs, chains, clusters
E4	BG 00-6-14-1-3	(2.5-3.75 um)X(3.75-5 um), budding, hyphae, pseudohyphae, globose-ellipsoid, single, pairs, chains, clusters
E4	BG 00-6-14-2-1	(2.5-3.75 um)X(2.5-5 um), budding, hyphae, pseudohyphae, globose-ellipsoid, single, pairs, chains, clusters
E4	BG 00-6-14-2-2	(2.5-3.75 um)X(2.5-5 um), budding, hyphae, pseudohyphae, globose-ellipsoid, single, pairs, chains, clusters
E4	BG 00-6-14-2-3	(2.5-5 um)X(3.75-6.25 um), budding, No hyphae or pseudohyphae, globose-ellipsoid, single, pairs, chains, clusters

[a] Observation includes: size, mode of reproduction, whether true hyphe or pseudohyphae or both are formed, shape, characteristics of cell aggregation

Table 4 (continued). Morphology of Vegetative Cells.

A. Growth in Yeast Malt (YM) Broth.

Grp	Isolate Number	Characteristics of Cells as Observed under Microscope[a]
E5	BG 99-8-11-1-4-1	(2.5-3.75 um)X(2.5-3.75 um), budding, No hyphae or pseudohyphae, globose-subglobose, single, pairs, chains, clusters
E6	BG 99-8-11-1-4-2	(3.75-5 um)X(5-6.25 um), budding, hyphae, pseudohyphae, subglobose-ellipsoid, single, pairs, chains, clusters
E7	BG 99-8-11-1-C1	(1.25-3.75 um)X(1.25-5 um), budding, No hyphae or pseudohyphae, subglobose-ellipsoid, single, pairs, chains, clusters
E8	BG 99-8-11-1-C2	(2.5-5 um)X(3.75-7.5 um), budding, pseudohyphae, subglobose-oval, single, pairs, chains
E9	BG 99-11-14-10-1-1	(2.5-6.25 um)X(2.5-6.25 um), budding, pseudohyphae, globose-subglobose, single, pairs, chains, clusters
E9	BG 99-11-14-10-2-1	(2.5-6.25 um)X(2.5-6.25 um), budding, pseudohyphae, globose-subglobose, single, pairs, chains, clusters
E9	BG 99-11-14-10-3-1	(2.5-6.25 um)X(2.5-6.25 um), budding, pseudohyphae, globose-subglobose, single, pairs, chains, clusters
E9	BG 99-11-14-10-3-2	(2.5-6.25 um)X(2.5-6.25 um), budding, No pseudohyphae, globose-subglobose, single, pairs, chains, clusters
E9	BG 99-11-14-11-1-1	(3.75-5 um)X(3.75-6.25 um), budding, pseudohyphae, globose-ellipsoid, single, pairs, chains, clusters
E9	BG 99-11-14-11-4-1	(2.5-5 um)X(3.75-7.5 um), budding, pseudohyphae, globose-ellipsoid, single, pairs, chains, clusters
E9	BG 99-11-14-11-5-1	(2.5-3.75 um)X(5-7.5 um), budding (multipolar), pseudohyphae, globose-ellipsoid, single, pairs, chains, clusters
E10	BG 99-11-14-10-4-1	(3.75 um)X(3.75-6.25 um), budding, No pseudohyphae, globose-oval, single, pairs, chains, clusters, elongated cells
E12	BG 00-8-15-4-1	(2.5-6.25 um)X(2.5-6.25 um), budding (multipolar), globose-subglobose, No hyphae or pseudohyphae, single, pairs, chains, clusters
T1	BG 98-8-18-2	(2.5-6.25 um)X(6.25-12.5 um), budding, pseudohyphae, globose-oval (some fusiform, elongated cells), single, pair, chain
T1	BG 98-12-9-1-1	(2.5-6.25 um)X(3.75-8.75 um), budding, pseudohyphae, globose-oval (some fusiform, elongated cells), single, pair, chain
T1	BG 98-12-9-1-3	(3.75-6.25 um)X(3.75-7.5 um), budding, pseudohyphae, globose-oval (some fusiform, elongated cells), single, pair, chain

[a] Observation includes: size, mode of reproduction, whether true hyphe or pseudohyphae or both are formed, shape, characteristics of cell aggregation

Table 4 (continued). Morphology of Vegetative Cells.

A. Growth in Yeast Malt (YM) Broth.

Grp	Isolate Number	Characteristics of Cells as Observed under Microscope[a]
T1	BG 99-2-5-2-1-1	(2.5-5 um)X(3.75-7.5 um), budding, pseudohyphae, globose-oval (some fusiform, elongated cells), single, pair, chain
T1	BG 99-2-5-2-1-2	(2.5-6.25 um)X(3.75-7.5 um), budding, pseudohyphae, globose-oval (some fusiform, elongated cells), single, pair, chain
T1	BG 99-3-22-1-1	(2.5-6.25 um)X(3.75-7.5 um), budding, pseudohyphae, globose-oval (some fusiform, elongated cells), single, pair, chain
T1	BG 99-3-22-1-2	(2.5-6.25 um)X(3.75-7.5 um), budding, pseudohyphae, globose-oval (some fusiform, elongated cells), single, pair, chain
T1	BG 99-3-22-1-3	(2.5-6.25 um)X(3.75-7.5 um), budding, pseudohyphae, globose-oval (some fusiform, elongated cells), single, pair, chain
T1	BG 99-3-22-1-4	(2.5-6.25 um)X(3.75-7.5 um), budding, pseudohyphae, globose-oval (some fusiform, elongated cells), single, pair, chain
T1	BG 99-9-28-1-4	(2.5-6.25 um)X(3.75-7.5 um), budding, pseudohyphae, globose-oval (some fusiform, elongated cells), single, pair, chain
T1	BG 00-6-7-1-1	(1.25-5 um)X(2.5-7.5 um), budding, pseudohyphae, globose-oval (some fusiform, elongated cells), single, pair, chain
T1	BG 00-6-7-1-2	(1.25-5 um)X(2.5-7.5 um), budding, pseudohyphae, globose-oval (some fusiform, elongated cells), single, pair, chain
T2	BG 98-12-9-1-2	slow or not cultivable in liquid media
T3	BG 98-9-24-3-1	slow or not cultivable in liquid media
T3	BG 98-9-24-3-2 s	slow or not cultivable in liquid media
T4	BG 98-9-2-2-4	(2.5-3.75 um)X(2.5-7.5 um), budding, pseudohyphae, ovoid-ellipsoidal, single, pairs, chains, clusters
T4	BG 00-6-23-2-1	(2.5-3.75 um)X(3.75-7.5 um), budding, No pseudohyphae, subglobose-ellipsoidal, single, pairs, chains, clusters
T4	BG 00-6-23-2-2	(2.5-6.25 um)X(3.75-7.5 um), budding, No pseudohyphae, ovoid-ellipsoidal, single, pairs, chains, clusters
T4	BG 00-6-26-1-2-1	(2.5-5 um)X(2.5-6.25 um), budding, No pseudohyphae, globose-ellipsoidal, single, pairs, chains, clusters
T4	BG 00-6-26-1-2-2	(2.5-5 um)X(2.5-6.25 um), budding, pseudohyphae, globose-ellipsoidal, single, pairs, chains, clusters
T4	BG 00-6-26-1-2-3	(2.5-6.25 um)X(2.5-6.25 um), budding, pseudohyphae, ovoid-ellipsoidal, single, pairs, chains, clusters
T4	BG 00-7-5-1-2-2	(2.5-5 um)X(2.5-6.25 um), budding, pseudohyphae, globose-ellipsoidal, single, pairs, chains, clusters

[a] Observation includes: size, mode of reproduction, whether true hyphe or pseudohyphae or both are formed, shape, characteristics of cell aggregation

Table 4 (continued). Morphology of Vegetative Cells.

A. Growth in Yeast Malt (YM) Broth.

Grp	Isolate Number	Characteristics of Cells as Observed under Microscope[a]
T4	BG 00-7-5-1-3-1	(2.5-5 um)X(2.5-6.25 um), budding, pseudohyphae, globose-ellipsoidal, single, pairs, chains, clusters
T4	BG 00-7-5-1-3-2	(2.5-5 um)X(2.5-6.25 um), budding, pseudohyphae, globose-ellipsoidal, single, pairs, chains, clusters
T4	BG 00-7-5-1-4-1	(2.5-5 um)X(2.5-6.25 um), budding, pseudohyphae, globose-ellipsoidal, single, pairs, chains, clusters
T4	BG 00-7-5-1-4-2	(2.5-5 um)X(3.75-6.25 um), budding, No pseudohyphae, globose-ellipsoidal, single, pairs, chains, clusters
T4	BG 00-6-23-1-1	(2.5-3.75 um)X(3.75-5 um), budding, pseudohyphae, globose-ellipsoidal, single, pairs, chains, clusters
T4	BG 00-6-23-1-2	(2.5-3.75 um)X(3.75-5 um), budding, No pseudohyphae, globose-ellipsoidal, single, pairs, chains, clusters
T4	BG 00-6-23-1-3	(2.5-5 um)X(2.5-5 um), budding, pseudohyphae, globose-ellipsoidal, single, pairs, chains, clusters
T5	BG 99-8-18-1-1	(2.5-3.75 um)X(2.5-3.75 um), budding, No pseudohyphae, globose-ellipsoidal, single, pairs, chains, clusters
T6	BG 99-8-18-1-3-1	(1.25-2.5 um)X(2.5 um), budding (?), No pseudohyphae, globose-ellipsoidal, single, pairs, chains, clusters
T6	BG 99-8-18-1-3-2	(1.25-3.75 um)X(2.5-3.75 um), budding, No pseudohyphae, globose-ellipsoidal, single, pairs, chains, clusters
T6	BG 99-8-18-1-6	(2.5-3.75 um)X(2.5-3.75 um), budding, No pseudohyphae, globose-ellipsoidal, single, pairs, chains, clusters
T7	BG 99-8-18-1-4-1	(2.5-5 um)X(3.75-6.25 um), budding, pseudohyphae, globose-ellipsoidal, single, pairs, chains, clusters
T7	BG 99-8-18-1-4-2	(2.5-3.75 um)X(2.5-5 um), budding, pseudohyphae, subglobose-ellipsoidal, single, pairs, chains, clusters
T9	BG 00-7-5-1-2-1	(2.5-5 um)X(2.5-5 um), budding, pseudohyphae, globose-subglobose, single, pairs, chains, clusters
T9	BG 00-7-5-1-2-3	(2.5-5 um)X(2.5-5 um), budding, pseudohyphae, globose-ellipsoidal, single, pairs, chains, clusters
T10	BG 00-6-26-2-2-1	(1.25-5 um)X(2.5-8.25 um), budding, small, pseudohyphae, globose-oval, elongated cells), single, pair, chain, clusters. white on glass wall
T11	BG 00-7-30-1-1	(2.5-5 um)X(2.5-5 um), budding, No pseudohyphae, globose-ellipsoidal, single, pairs, chains, clusters

[a] Observation includes: size, mode of reproduction, whether true hyphe or pseudohyphae or both are formed, shape, characteristics of cell aggregation

Table 4 (continued). Morphology of Vegetative Cells.

A. Growth in Yeast Malt (YM) Broth.

Grp	Isolate Number	Characteristics of Cells as Observed under Microscope[a]
T11	BG 00-7-30-1-2	(2.5-5 um)X(2.5-5 um), budding, No pseudohyphae, globose-ellipsoidal, single, pairs, chains, clusters
T11	BG 00-7-30-1-C	(2.5-6.25 um)X(3.75-6.25 um), budding, No pseudohyphae, globose-oval, single, pairs, chains, clusters
T11	BG 00-8-15-1-1	(1.25-2.5 um)X(1.25-3.75 um), budding, No pseudohyphae, globose-subglobose, single, pairs, chains, clusters
N1	BG 98-8-14-1-2-1	(1.25-3.75 um)X(2.5-3.75 um), budding, No pseudohyphae, subglobose-oval, single, pairs, chains, clusters
N1	BG 98-8-14-1-3-3	(2.5-3.75 um)X(2.5-3.75 um), budding, hyphae, pseudohyphae, globose-ellipsoid, single, pairs, chains, clusters
N1	BG 98-8-14-1-4-3	(2.5-3.75 um)X(2.5-3.75 um), budding, No hyphae or pseudohyphae, globose-ellipsoid, single, pairs, chains, clusters
N2	BG 98-8-14-1-3-1	(2.5-5 um)X(2.5-5 um), budding, hyphae, pseudohyphae, globose-ellipsoid, single, pairs, chains, clusters
N3	BG 98-8-14-1-3-2	(2.5-5 um)X(2.5-5 um), budding, No hyphae or pseudohyphae, globose-ellipsoid, single, pairs, chains, clusters
N3	BG 98-8-14-1-4-2	(3.75-5 um)X(3.75-5 um), budding, No hyphae or pseudohyphae, globose-ellipsoid, single, pairs, chains, clusters
N4	BG 98-8-14-1-4-1	(2.5-3.75 um)X(5-7.5 um) few cells in liquid media, budding, hyphae, pseudohyphae, ellipsoid-fusiform, single, pairs, chains, clusters
C1	BG 98-12-9-2-1	(2.5-5 um)X(2.5-7.5 um), budding, pseudohyphae, globose-oval, single, clusters
C1	BG 98-12-9-2-2-1	(2.5-5 um)X(2.5-7.5 um), budding, pseudohyphae, globose-oval, single, clusters
C1	BG 98-12-9-2-2-2	(2.5-5 um)X(2.5-7.5 um), budding, pseudohyphae, globose-oval, single, clusters
C2	BG 99-2-5-7-1-1	(2.5-7.5 um)X(2.5-7.5 um), budding, No pseudohyphae, globose-subglobose, single
C2	BG 99-2-5-7-1-2	(2.5-7.5 um)X(2.5-7.5 um), budding, pseudohyphae, globose-subglobose, single
C2	BG 99-2-5-7-1-3	(2.5-7.5 um)X(2.5-7.5 um), budding, pseudohyphae, globose-subglobose, single, elongated cells
S1	BG 98-8-5-1-1	(2.5-3.75 um)X(2.5-3.75 um), budding, hyphae, pseudohyphae, globose-subglobose, single, pairs, chains, clusters
M1	BG 99-11-14-1-4-1	(3.75-6.25 um)X(5-7.5 um), budding, subglobose, irregular, single, elongated cells

[a] Observation includes: size, mode of reproduction, whether true hyphe or pseudohyphae or both are formed, shape, characteristics of cell aggregation

Table 4 (continued). Morphology of Vegetative Cells.

A. Growth in Yeast Malt (YM) Broth.

Grp	Isolate Number	Characteristics of Cells as Observed under Microscope[a]
M2	BG 99-11-14-1-4-2	(2.5-6.25 um)X(3.75-7.5 um), budding, No pseudohyphae oval, single
D1	BG 99-11-14-5-2-1	(3.75-6.25 um)X(3.75-6.25 um), budding, hyphae, pseudohyphae, subglobose-ellipsoid, single, pairs, chains, clusters
D1	BG 99-11-14-8-2-1	(2.5-3.75 um)X(3.75-7.5 um), budding, No pseudohyphae, oval-ellipsoid, single, pairs, chains, clusters
D1	BG 99-11-14-8-3-1	(1.25 um)X(1.25 um), poor growth, cells very small, budding, No hyphae or pseudohyphae, globose, single
D2	BG 99-11-14-7-C	(2.5-5 um)X(3.75-5 um), budding, No hyphae or pseudohyphae, globose-fusiform, single, pairs, chains, clusters

[a] Observation includes: size, mode of reproduction, whether true hyphe or pseudohyphae or both are formed, shape, characteristics of cell aggregation

Table 4 (continued). Morphology of Vegetative Cells.

B. Growth on Yeast Malt (YM) Agar.

Grp	Isolate Number	Appearance of Colony Growth on YM Agar for 7 Days
E1	BG 98-8-25-1-2	white to cream color with very pale pinkish from center to edge, surface: wrinkled
E1	BG 98-8-25-1-4	white to cream color with very pale pinkish from center to edge, surface: wrinkled
E1	BG 98-8-25-1-5	white to cream color with very pale pinkish from center to edge, surface: wrinkled
E1	BG 98-9-24-2-1	white to cream color with very pale pinkish from center to edge, surface: smooth to slightly wrinkled center
E2	BG 99-6-12-1-1	white to cream color, surface: rough, wrinkled, mycelial edge
E3	BG 99-8-11-1-1	white to cream color with very pale pinkish from center to edge, surface: smooth to slightly wrinkled center, mycelial edge
E3	BG 99-8-11-1-2-1	white to cream color, surface: smooth to slightly wrinkled edge, mycelia
E3	BG 99-8-11-1-2-3	white to cream color with very pale pinkish from center to edge, surface: smooth to slightly wrinkled center, mycelial edge
E3	BG 99-8-11-1-3	white to cream color with very pale pinkish from center to edge, surface: smooth to slightly wrinkled center, mycelial edge
E4	BG 99-8-11-1-2-2	white to cream color with very pale pinkish center, surface: smooth to slightly wrinkled center
E4	BG 99-8-11-1-2-4	white to cream color with very pale pinkish from center, surface: smooth, slightly wrinkled, mycelial edge
E4	BG 00-6-14-1-1	white to cream color with very pale pinkish from center, surface: smooth, slightly wrinkled, mycelial edge
E4	BG 00-6-14-1-2	white to cream color with very pale pinkish from center, surface: smooth, slightly wrinkled, mycelial edge
E4	BG 00-6-14-1-3	white to cream color with very pale pinkish from center, surface: smooth, slightly wrinkled, mycelial edge
E4	BG 00-6-14-2-1	white to cream color with very pale pinkish from center, surface: smooth, slightly wrinkled, mycelial edge
E4	BG 00-6-14-2-2	white to cream color with very pale pinkish from center, surface: smooth, slightly wrinkled, mycelial edge
E4	BG 00-6-14-2-3	white to cream color with very pale pinkish from center, surface: smooth, slightly wrinkled, mycelial edge
E5	BG 99-8-11-1-4-1	white to cream color, surface: smooth
E6	BG 99-8-11-1-4-2	white to cream color, surface: smooth, slightly wrinkled center
E7	BG 99-8-11-1-C1	white color, surface: smooth
E8	BG 99-8-11-1-C2	white to creamed, surface: wrinkled, mycelial edge

Table 4 (continued). Morphology of Vegetative Cells.

B. Growth on Yeast Malt (YM) Agar.

Grp	Isolate Number	Appearance of Colony Growth on YM Agar for 7 Days
E9	BG 99-11-14-10-1-1	white to cream color, surface: smooth, partly powdery
E9	BG 99-11-14-10-2-1	white to cream color, surface: smooth, partly powdery, mycelial edge
E9	BG 99-11-14-10-3-1	white to cream color, surface: smooth
E9	BG 99-11-14-10-3-2	white to cream color, surface: smooth, partly powdery, mycelial edge
E9	BG 99-11-14-11-1-1	white to cream color, surface: smooth, partly powdery, mycelial edge, under agar
E9	BG 99-11-14-11-4-1	white to cream color, surface: smooth, partly powdery, mycelial edge
E9	BG 99-11-14-11-5-1	white to cream color, surface: smooth
E10	BG 99-11-14-10-4-1	white to cream color, surface: smooth
T1	BG 98-8-18-2	white to cream color, surface: smooth, wrinkled edge
T1	BG 98-12-9-1-1	white color, surface: smooth
T1	BG 98-12-9-1-3	white to cream color, surface: smooth, wrinkled edge
T1	BG 99-2-5-2-1-1	white to cream color, surface: smooth, wrinkled edge
T1	BG 99-2-5-2-1-2	white to cream color, surface: smooth, wrinkled edge
T1	BG 99-3-22-1-1	white to cream color, surface: smooth, slightly wrinkled edge
T1	BG 99-3-22-1-2	white to cream color, surface: smooth, slightly wrinkled edge
T1	BG 99-3-22-1-3	white to cream color, surface: smooth, slightly wrinkled edge
T1	BG 99-3-22-1-4	white to cream color, surface: smooth, slightly wrinkled edge
T1	BG 99-9-28-1-4	white to cream color, surface: smooth, slightly wrinkled edge
T1	BG 00-6-7-1-1	white to cream color, surface: smooth, slightly wrinkled edge
T1	BG 00-6-7-1-2	white to cream color, surface: smooth, slightly wrinkled edge
T2	BG 98-12-9-1-2	cream color, surface: mucoid, gelly, shiny
T3	BG 98-9-24-3-1	cream color, surface: mucoid, gelly, shiny
T3	BG 98-9-24-3-2	cream color, surface: mucoid, gelly, shiny
T4	BG 98-9-2-2-4	white to cream color with very pale pinkish from center to edge, surface: smooth, mycelial edge
T4	BG 00-6-23-2-1	white to cream color with very pale pinkish from center to edge, surface: smooth
T4	BG 00-6-23-2-2	white to cream color with very pale pinkish from center to edge, surface: smooth
T4	BG 00-6-26-1-2-1	white to cream color with very pale pinkish from center to edge, surface: smooth, wrinkled center, mycelial edge
T4	BG 00-6-26-1-2-2	white to cream colorwith very pale pinkish from center to edge, surface: smooth, slightly wrinkled, mycelial edge
T4	BG 00-6-26-1-2-3	white to cream color with very pale pinkish from center to edge, surface: smooth, slightly wrinkled, mycelial edge
T4	BG 00-7-5-1-2-2	cream color with very pale pinkish from center to edge, surface: smooth
T4	BG 00-7-5-1-3-1	cream color with very pale pinkish from center to edge, surface: smooth
T4	BG 00-7-5-1-3-2	cream color with very pale pinkish from center to edge, surface: smooth

Table 4 (continued). Morphology of Vegetative Cells.

B. Growth on Yeast Malt (YM) Agar.

Grp	Isolate Number	Appearance of Colony Growth on YM Agar for 7 Days
T4	BG 00-7-5-1-4-1	cream color with very pale pinkish from center to edge, surface: smooth
T4	BG 00-7-5-1-4-2	cream color with very pale pinkish from center to edge, surface: smooth
T4	BG 00-6-23-1-1	cream color with very pale pinkish from center to edge, surface: smooth
T4	BG 00-6-23-1-2	cream color with very pale pinkish from center to edge, surface: smooth
T4	BG 00-6-23-1-3	cream color with very pale pinkish from center to edge, surface: smooth, slightly wrinkled, mycelial edge
T5	BG 99-8-18-1-1	cream color with very pale pinkish from center to edge, surface: smooth
T6	BG 99-8-18-1-3-1	white to cream color with very pale pinkish from center to edge, surface: smooth, glossy
T6	BG 99-8-18-1-3-2	white to cream color with very pale orange, surface: smooth, glossy
T6	BG 99-8-18-1-6	white to cream color with very pale orange, surface: smooth, glossy
T7	BG 99-8-18-1-4-1	white to cream color, surface: rough, partly powdery, wrinkled mycelial edge
T7	BG 99-8-18-1-4-2	white to cream color, surface: rough, partly powdery, wrinkled mycelial edge
T9	BG 00-7-5-1-2-1	white to cream color, surface: rough, partly powdery, wrinkled
T9	BG 00-7-5-1-2-3	white to cream color with very pale pinkish from center to edge, surface: rough, partly powdery, wrinkled
T10	BG 00-6-26-2-2-1	white to cream color with very pale pinkish from center to edge, surface: rough, wrinkled
T11	BG 00-7-30-1-1	white to cream color, surface: smooth
T11	BG 00-7-30-1-2	white to cream color, surface: smooth
T11	BG 00-7-30-1-C	white to cream color, surface: smooth
N1	BG 98-8-14-1-2-1	white to cream color, surface: smooth
N1	BG 98-8-14-1-3-3	white to cream color, surface: smooth
N1	BG 98-8-14-1-4-3	white to cream color with very pale pinkish from center to edge, surface: smooth
N2	BG 98-8-14-1-3-1	white to cream color, surface: rough, wrinkled ring
N3	BG 98-8-14-1-3-2	white to cream color with very pale pinkish from center to edge, surface: smooth but not shiny
N3	BG 98-8-14-1-4-2	white to cream colorwith very pale pinkish from center to edge, surface: smooth but not shiny
C1	BG 98-12-9-2-1	white to cream color, surface: rough, wrinkled, mycelial edge
C1	BG 98-12-9-2-2-1	white to cream color, surface: rough, wrinkled, mycelial edge
C1	BG 98-12-9-2-2-2	white to cream color, surface: rough, wrinkled, mycelial edge

Table 4 (continued). Morphology of Vegetative Cells.

B. Growth on Yeast Malt (YM) Agar.

Grp	Isolate Number	Appearance of Colony Growth on YM Agar for 7 Days
C2	BG 99-2-5-7-1-1	white to cream color, surface: smooth
C2	BG 99-2-5-7-1-2	white to cream color, surface: smooth, wrinkled edge
C2	BG 99-2-5-7-1-3	white to cream color, surface: smooth, wrinkled mycelial edge
S1	BG 98-8-5-1-1	white to cream color, surface: smooth, glossy
M1	BG 99-11-14-1-4-1	white to cream color, surface: rough, wrinkled, powdery
M2	BG 99-11-14-1-4-2	white to cream color, surface: smooth
D1	BG 99-11-14-5-2-1	white to cream color with very pale pinkish from center to edge, surface: smooth
D1	BG 99-11-14-8-2-1	white to cream color with very pale pinkish from center to edge, surface: smooth
D1	BG 99-11-14-8-3-1	white to creamed with very pale pinkish from center to edge, surface: smooth
D2	BG 99-11-14-7-C	white to cream color, surface: smooth

Table 4 (continued). Morphology of Vegetative Cells.

C. Growth on Corn Meal (YM) Agar.

Grp	Isolate Number	Appearance of Colony Growth on CM Agar for 7 Days
E1	BG 98-8-25-1-2	white, shiny, smooth, more growth at perimeter, branch-like peripery, pseudohyphae, hyphae
E1	BG 98-8-25-1-4	white, shiny, smooth, more growth at perimeter, branch-like peripery, pseudohyphae, hyphae
E1	BG 98-8-25-1-5	white, shiny, smooth, more growth at perimeter, branch-like peripery, pseudohyphae, hyphae
E1	BG 98-9-24-2-1	white, shiny, smooth, more growth at perimeter, branch-like peripery, pseudohyphae, hyphae
E2	BG 99-6-12-1-1	white, shiny, smooth, more growth at perimeter, branch-like peripery, pseudohyphae, hyphae (thin, two or more conidia produced on one site)
E3	BG 99-8-11-1-1	white, shiny, smooth, more growth at perimeter, branch-like peripery, pseudohyphae, hyphae
E3	BG 99-8-11-1-2-1	white, shiny, smooth, growth consistent throughout, no branch-like peripery, no pseudohyphae or hyphae
E3	BG 99-8-11-1-2-3	white, shiny, smooth, growth consistent throughout, branch-like peripery, pseudohyphae, hyphae
E3	BG 99-8-11-1-3	white, shiny, smooth, growth consistent throughout mycelium, filamentous-like peripery, pseudohyphae, hyphae
E4	BG 99-8-11-1-2-2	white, shiny, smooth, growth consistent throughout mycelium, filamentous-like peripery, pseudohyphae, hyphae
E4	BG 99-8-11-1-2-4	white, shiny, smooth, growth consistent throughout mycelium, filamentous-like peripery, pseudohyphae, hyphae
E4	BG 00-6-14-1-1	white, shiny, smooth, growth consistent throughout mycelium, filamentous-like peripery, pseudohyphae, hyphae
E4	BG 00-6-14-1-2	white, shiny, smooth, more growth at perimeter, branch-like peripery, pseudohyphae, hyphae
E4	BG 00-6-14-1-3	white, shiny, smooth, growth consistent throughout mycelium, filamentous-like peripery, pseudohyphae, hyphae
E4	BG 00-6-14-2-1	white, shiny, smooth, growth consistent throughout mycelium, filamentous-like peripery, pseudohyphae, hyphae
E4	BG 00-6-14-2-2	white, shiny, smooth, growth consistent throughout mycelium, filamentous-like peripery, pseudohyphae, hyphae
E4	BG 00-6-14-2-3	white, shiny, smooth, growth consistent throughout mycelium, filamentous-like peripery, pseudohyphae, hyphae
E5	BG 99-8-11-1-4-1	white, shiny, smooth, more growth at perimeter, no branch-like peripery, no pseudohyphae or hyphae
E6	BG 99-8-11-1-4-2	white, shiny, smooth, more growth at perimeter, branch-like peripery, pseudohyphae, hyphae
E7	BG 99-8-11-1-C1	white, shiny, smooth, more growth at perimeter, no branch-like peripery, no pseudohyphae or hyphae
E8	BG 99-8-11-1-C2	white, powdery, mycelium edge, septated hyphae, pseudohyphae with short branches

Table 4 (continued). Morphology of Vegetative Cells.

C. Growth on Corn Meal (CM) Agar.

Grp	Isolate Number	Appearance of Colony Growth on CM Agar for 7 Days
E9	BG 99-11-14-10-1-1	white, shiny, smooth, more growth at perimeter, hyphae (septated, thick, holoblastic conidia), pseudohyphae
E9	BG 99-11-14-10-2-1	white, shiny, smooth, more growth at perimeter, hyphae (septated, thick, holoblastic conidia), pseudohyphae
E9	BG 99-11-14-10-3-1	white, shiny, smooth, more growth at perimeter, hyphae (septated, thick, holoblastic conidia), pseudohyphae
E9	BG 99-11-14-10-3-2	white, shiny, smooth, more growth at perimeter, hyphae (septated, thick, holoblastic conidia), pseudohyphae
E9	BG 99-11-14-11-1-1	white, shiny, smooth, more growth at perimeter, hyphae (septated, thick, holoblastic conidia), pseudohyphae
E9	BG 99-11-14-11-4-1	white, shiny, smooth, more growth at perimeter, hyphae (septated, thick, holoblastic conidia), pseudohyphae
E10	BG 99-11-14-10-4-1	white, shiny, smooth, more growth at perimeter, hyphae (slow growth, septated, thick, holoblastic conidia), pseudohyphae
E12	BG 00-8-15-4-1	white, shiny, smooth, growth consistent, no pseudohyphae or hyphae
T1	BG 98-8-18-2	white, shiny, smooth, more growth at perimeter, branch-like peripery, pseudohyphae
T1	BG 98-12-9-1-1	white, shiny, smooth, more growth at perimeter, branch-like peripery, pseudohyphae
T1	BG 98-12-9-1-3	white, shiny, smooth, more growth at perimeter, cilia-like peripery, pseudohyphae
T1	BG 99-2-5-2-1-1	white, shiny, smooth, more growth at perimeter, filamentous-like peripery, pseudohyphae
T1	BG 99-2-5-2-1-2	white, shiny, smooth, more growth at perimeter, filamentous-like peripery, pseudohyphae
T1	BG 99-3-22-1-1	white, shiny, smooth, more growth at perimeter, filamentous-like peripery, pseudohyphae
T1	BG 99-3-22-1-2	white, shiny, smooth, more growth at perimeter, filamentous-like peripery, pseudohyphae
T1	BG 99-3-22-1-3	white, shiny, smooth, more growth at perimeter, filamentous-like peripery, pseudohyphae
T1	BG 99-3-22-1-4	white, shiny, smooth, more growth at perimeter, filamentous-like peripery, pseudohyphae
T1	BG 99-9-28-1-4	white, shiny, smooth, more growth at perimeter, cilia-like peripery, pseudohyphae
T1	BG 00-6-7-1-1	white, shiny, smooth, more growth at perimeter, filamentous-like peripery, pseudohyphae
T1	BG 00-6-7-1-2	white, shiny, smooth, more growth at perimeter, filamentous-like peripery, pseudohyphae
T2	BG 98-12-9-1-2	white, shiny, smooth, gel-like, consistent growth throughout, no pseudohyphae
T3	BG 98-9-24-3-1	white, shiny, smooth, gel-like, consistent growth throughout, no pseudohyphae
T3	BG 98-9-24-3-2	white, shiny, smooth, gel-like, consistent growth throughout, no pseudohyphae
T4	BG 98-9-2-2-4	white, shiny, smooth, more growth at perimeter, filamentous-like peripery, pseudohyphae
T4	BG 00-6-23-2-1	white, shiny, smooth, more growth at perimeter, filamentous-like peripery, pseudohyphae
T4	BG 00-6-23-2-2	white, shiny, smooth, more growth at perimeter, filamentous-like peripery, pseudohyphae
T4	BG 00-6-26-1-2-1	white, shiny, smooth, more growth at perimeter, filamentous-like peripery, pseudohyphae

Table 4 (continued). Morphology of Vegetative Cells.

C. Growth on Corn Meal (CM) Agar.

Grp	Isolate Number	Appearance of Colony Growth on CM Agar for 7 Days
T4	BG 00-6-26-1-2-2	white, shiny, smooth, more growth at perimeter, filamentous-like peripery, pseudohyphae
T4	BG 00-6-26-1-2-3	white, shiny, smooth, more growth at perimeter, filamentous-like peripery, pseudohyphae
T4	BG 00-7-5-1-2-2	white, shiny, smooth, more growth at perimeter, filamentous-like peripery, pseudohyphae
T4	BG 00-7-5-1-3-1	white, shiny, smooth, more growth at perimeter, filamentous-like peripery, pseudohyphae
T4	BG 00-7-5-1-3-2	white, shiny, smooth, more growth at perimeter, filamentous-like peripery, pseudohyphae
T4	BG 00-7-5-1-4-1	white, shiny, smooth, more growth at perimeter, filamentous-like peripery, pseudohyphae
T4	BG 00-7-5-1-4-2	white, shiny, smooth, more growth at perimeter, filamentous-like peripery, pseudohyphae
T4	BG 00-6-23-1-1	white, shiny, smooth, growth consistent throughout mycelium, filamentous-like peripery, pseudohyphae
T4	BG 00-6-23-1-2	white, shiny, smooth, more growth at perimeter, filamentous-like peripery, pseudohyphae
T4	BG 00-6-23-1-3	white, shiny, smooth, more growth at perimeter, filamentous-like peripery, pseudohyphae
T5	BG 99-8-18-1-1	white, shiny, smooth, more growth at perimeter, filamentous-like peripery, pseudohyphae
T6	BG 99-8-18-1-3-1	white, shiny, smooth, growth consistent throughout mycelium, no pseudohyphae
T6	BG 99-8-18-1-3-2	white, shiny, smooth, growth consistent throughout mycelium, no pseudohyphae
T6	BG 99-8-18-1-6	white, shiny, smooth, growth consistent throughout mycelium, no pseudohyphae
T7	BG 99-8-18-1-4-1	white, dull, dry, powdery, consistent growth throughout mycelium, branch-like peripery, pseudohyphae
T7	BG 99-8-18-1-4-2	white, dull, dry, powdery, consistent growth throughout mycelium, branch-like peripery, pseudohyphae
T9	BG 00-7-5-1-2-1	white, slight yellow perimeter, dull, dry, powdery, consistent growth throughout mycelium, gel-like peripery, pseudohyphae
T9	BG 00-7-5-1-2-3	white, dull, dry, powdery, consistent growth throughout mycelium, branch-like peripery, pseudohyphae
T10	BG 00-6-26-2-2-1	white, dull, dry, powdery, rough, little more growth at perimeter, fine hair-like peripery, pseudohyphae
T11	BG 00-7-30-1-1	white, shiny, smooth, growth consistent throughout mycelium, branch-like peripery, pseudohyphae, hyphae (septated) holoblastic conidia
T11	BG 00-7-30-1-2	white, shiny, smooth, growth consistent throughout mycelium, branch-like peripery, pseudohyphae
T11	BG 00-7-30-1-C	white, shiny, smooth, growth consistent throughout mycelium, branch-like peripery, pseudohyphae, hyphae (septated) holoblastic conidia
T11	BG 00-8-15-1-1	white, shiny, smooth, growth consistent throughout mycelium, branch-like peripery, pseudohyphae, hyphae (septated) holoblastic conidia

Table 4 (continued). Morphology of Vegetative Cells.

C. Growth on Corn Meal (CM) Agar.

Grp	Isolate Number	Appearance of Colony Growth on CM Agar for 7 Days
N1	BG 98-8-14-1-2-1	white, shiny, smooth, hyphae (no septa) growth slow in aerobic but abundant in anaerobic, asymetric conidia
N1	BG 98-8-14-1-3-3	white, shiny, smooth, pseudohyphae (elongated cell to two branches), asymetric conidia
N1	BG 98-8-14-1-4-3	white, shiny, smooth, no pseudohyphae
N2	BG 98-8-14-1-3-1	white, wrinkle, growth consistent, pseudohyphae, thick septated hyphae (holoblastic condia)
N3	BG 98-8-14-1-3-2	white, rough, powdery, growth consistent, no pseudohyphae
N3	BG 98-8-14-1-4-2	white, rough, powdery, growth consistent, no pseudohyphae
N4	BG 98-8-14-1-4-1	white, rough, growth consistent, septated hyphae (5-6 conifdia cluster on a branch) in both aerobic and anaerobic, pseudohyphae
C1	BG 98-12-9-2-1	white, dull, dry, smooth(?) center powdery perimeter, fine branch-like peripery, pseudohyphae
C1	BG 98-12-9-2-2-1	white, dull, dry, powdery, more growth at perimeter, fine hair-like peripery, pseudohyphae
C1	BG 98-12-9-2-2-2	white, dull, dry, powdery, consistent growth throughout mycelium, branch-like peripery, pseudohyphae
C2	BG 99-2-5-7-1-1	white, shiny, smooth, consistent growth throughout mycelium, branch-like peripery, no pseudohyphae
C2	BG 99-2-5-7-1-2	white, shiny, smooth, gel-like, more growth at perimeter, branch-like peripery, pseudohyphae
C2	BG 99-2-5-7-1-3	white, shiny, smooth, gel-like, more growth at perimeter, branch-like peripery, pseudohyphae
S1	BG 98-8-5-1-1	white, shiny, smooth, consistent growth throughout mycelium, branch-like peripery, pseudohyphae, hyphae (conidia cluster)
M1	BG 99-11-14-1-4-1	white, dull, dry, powdery, patchy growth throughout mycelium, branch-like peripery, pseudohyphae
M2	BG 99-11-14-1-4-2	white, shiny, smooth, growth slightly more at perimeter, branch-like peripery, pseudohyphae
D1	BG 99-11-14-5-2-1	white, shiny, smooth, growth consistent throughout mycelium, branch-like peripery, seudohyphae, hyphae
D1	BG 99-11-14-8-2-1	white, shiny, smooth, hyphae abundant in both aero and anaerobic, pseudohyphae, hyphae (septated)
D1	BG 99-11-14-8-3-1	white, shiny, smooth, slightly more growth at perimeter, branch-like peripery, pseudohyphae
D2	BG 99-11-14-7-C	white, shiny, smooth, more growth at perimeter, branch-like peripery, pseudohyphae

Table 5. Results of the *Fermentation of Carbohydrates Test.*

Grp	Isolate Number	Carbohydrate[a]													
		Glu	Gal	Mal	αGl	Suc	Tre	Mel	Lac	Cel	Mel	Raf	Inu	Sta	Xyl
E1	BG 98-8-25-1-2	+	w	l	-	-	+	-	-	-	w	-	-	-	-
E1	BG 98-8-25-1-4	+	s	l	-	-	+	N	-	w	N	-	N	-	-
E1	BG 98-8-25-1-5	+	w	s	-	-	+	N	-	w	N	-	N	-	-
E1	BG 98-9-24-2-1	+	w	s	-	-	l	N	-	-	N	-	N	-	-
E2	BG 99-6-12-1-1	+	s	w	-	-	+	+	-	-	w	-	-	-	-
E3	BG 99-8-11-1-1	+	l	-	-	-	s	-	-	-	-	-	-	-	-
E3	BG 99-8-11-1-2-1	+	l	-	-	-	s	N	-	-	N	-	N	-	-
E3	BG 99-8-11-1-2-3	w	s	-	-	-	s	N	-	-	N	-	N	-	-
E3	BG 99-8-11-1-3	l	s	-	-	-	s	N	-	-	N	-	N	-	-
E4	BG 99-8-11-1-2-2	l	-	-	-	-	w	-	-	-	w	-	-	-	-
E4	BG 99-8-11-1-2-4	w	-	-	-	-	w	-	-	-	-	-	-	-	-
E4	BG 00-6-14-1-1	w	-	-	-	-	w	N	-	-	N	-	N	-	-
E4	BG 00-6-14-1-2	+	-	-	-	-	w	N	-	-	N	-	N	-	-
E4	BG 00-6-14-1-3	l	-	-	-	-	w	N	-	-	N	-	N	-	-
E4	BG 00-6-14-2-1	s	-	-	-	-	w	-	-	-	-	-	-	-	-
E4	BG 00-6-14-2-2	s	-	-	-	-	-	-	-	-	-	-	-	-	-
E4	BG 00-6-14-2-3	s	-	-	-	-	-	-	-	-	-	-	-	-	-
E5	BG 99-8-11-1-4-1	+	-	w	w	+	s	+	-	s	w	+	-	-	-
E6	BG 99-8-11-1-4-2	+	l	-	-	-	+	-	-	-	-	-	-	-	-
E7	BG 99-8-11-1-C1	+	-	w	-	-	w	-	-	-	-	-	-	-	-
E8	BG 99-8-11-1-C2	+	l	w	-	w	+	-	-	-	-	-	-	-	-
E9	BG 99-11-14-10-1-1	+	s	-	-	-	w	-	-	-	-	-	-	-	-
E9	BG 99-11-14-10-2-1	+	+	-	-	-	+	N	-	-	N	-	N	-	-
E9	BG 99-11-14-10-3-1	+	+	-	-	-	+	N	-	-	N	-	N	-	-
E9	BG 99-11-14-10-3-2	+	s	-	-	-	+	-	-	-	-	-	-	-	-
E9	BG 99-11-14-11-1-1	+	l	-	-	-	+	-	-	-	-	-	-	-	-
E9	BG 99-11-14-11-4-1	+	+	-	-	-	+	N	-	-	N	-	N	-	-
E9	BG 99-11-14-11-5-1	+	l	-	-	-	+	-	-	-	-	-	-	-	-

[a] Abbreviations: Glu, D-glucose; Gal, D-galactose; Mal, Maltose; αGl, α-methyl-D-glucoside; Suc, Sucrose; Tre, α-α-trehalose; Mel, melibose; Lac, Lactose; Cel, Cellobiose; Mel, Melezitose; Raf, Raffinose; Inu, Inulin; Sta, Starch; Xyl, Xylose
Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; -, negative; N, no data

Table 5 (continued). Results of the *Fermentation of Carbohydrates Test.*

Grp	Isolate Number	Carbohydrate[a]													
		Glu	Gal	Mal	αGl	Suc	Tre	Mel	Lac	Cel	Mel	Raf	Inu	Sta	Xyl
E10	BG 99-11-14-10-4-1	+	–	–	–	–	–	–	–	+	–	–	–	–	–
E12	BG 00-8-15-4-1	+	–	–	–	–	w	–	–	–	–	–	–	–	–
T1	BG 98-8-18-2	+	+	–	–	–	+	–	–	–	w	–	–	–	–
T1	BG 98-12-9-1-1	+	l	–	–	–	l	N	–	–	N	–	N	–	–
T1	BG 98-12-9-1-3	+	+	–	–	+	+	N	–	–	N	–	N	–	–
T1	BG 99-2-5-2-1-1	l	l	–	–	–	+	–	–	–	–	–	–	–	–
T1	BG 99-2-5-2-1-2	+	l	–	–	–	s	–	–	–	–	–	–	–	–
T1	BG 99-3-22-1-1	+	w	–	–	–	+	–	–	–	–	–	–	–	–
T1	BG 99-3-22-1-2	+	+	–	–	–	+	–	–	s	–	–	–	–	–
T1	BG 99-3-22-1-3	+	+	–	–	–	+	–	–	w	–	–	–	–	–
T1	BG 99-3-22-1-4	+	+	–	–	–	+	N	–	–	N	–	N	–	–
T1	BG 99-9-28-1-4	+	+	–	–	–	+	–	–	–	–	–	–	–	–
T1	BG 00-6-7-1-1	+	l	–	–	–	l	–	–	–	–	–	–	–	–
T1	BG 00-6-7-1-2	+	+	–	–	–	+	–	–	–	–	–	–	–	–
T2	BG 98-12-9-1-2	–	–	–	–	–	–	–	–	–	–	–	–	–	–
T3	BG 98-9-24-3-1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
T3	BG 98-9-24-3-2	–	–	–	–	–	–	N	–	–	N	–	N	–	–
T4	BG 98-9-2-2-4	l	–	–	–	–	w	–	–	–	–	–	–	–	–
T4	BG 00-6-23-2-1	+	–	–	–	–	s	N	–	–	N	–	N	–	–
T4	BG 00-6-23-2-2	+	–	–	–	–	s	–	–	–	–	–	–	–	–
T4	BG 00-6-26-1-2-1	+	–	–	–	–	–	–	–	–	–	–	–	–	–
T4	BG 00-6-26-1-2-2	+	–	–	–	–	+	–	–	–	–	–	–	–	–
T4	BG 00-6-26-1-2-3	+	–	–	–	–	+	–	–	–	–	–	–	–	–
T4	BG 00-7-5-1-2-2	–	w	–	–	–	w	–	–	–	–	–	–	–	–
T4	BG 00-7-5-1-3-1	s	–	–	–	–	–	–	–	–	–	–	–	–	–
T4	BG 00-7-5-1-3-2	+	–	–	–	–	+	–	–	w	–	–	–	–	–
T4	BG 00-7-5-1-4-1	+	–	–	–	–	l	–	–	w	–	–	–	–	–
T4	BG 00-7-5-1-4-2	+	–	–	–	–	+	–	–	w	–	–	–	–	–
T4	BG 00-6-23-1-1	+	–	–	–	–	s	N	–	–	N	–	N	–	–
T4	BG 00-6-23-1-2	+	–	–	–	–	s	N	–	–	N	–	N	–	–

[a] Abbreviations: Glu, D-glucose; Gal, D-galactose; Mal, Maltose; αGl, α-methyl-D-glucoside; Suc, Sucrose; Tre, α-α-trehalose; Mel, melibose; Lac, Lactose; Cel, Cellobiose; Mel, Melezitose; Raf, Raffinose; Inu, Inulin; Sta, Starch; Xyl, Xylose
Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; –, negative; N, no data

Table 5 (continued). Results of the *Fermentation of Carbohydrates Test.*

Grp	Isolate Number	Carbohydrate[a]													
		Glu	Gal	Mal	αGl	Suc	Tre	Mel	Lac	Cel	Mel	Raf	Inu	Sta	Xyl
T4	BG 00-6-23-1-3	+	w	–	–	–	l	–	–	w	–	–	–	–	–
T5	BG 99-8-18-1-1	l	–	–	–	–	s	–	–	–	–	–	–	–	–
T6	BG 99-8-18-1-3-1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
T6	BG 99-8-18-1-3-2	–	–	–	–	–	–	N	–	–	N	–	N	–	–
T6	BG 99-8-18-1-6	–	–	–	–	–	–	–	–	–	–	–	–	–	–
T7	BG 99-8-18-1-4-1	+	s	s	–	s	+	–	–	–	–	–	–	–	–
T7	BG 99-8-18-1-4-2	+	l	w	–	s	+	N	–	–	N	–	N	–	–
T9	BG 00-7-5-1-2-1	w	s	+	–	–	+	–	–	w	–	–	–	–	–
T9	BG 00-7-5-1-2-3	+	w	w	–	–	+	–	–	–	–	–	–	–	–
T10	BG 00-6-26-2-2-1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
T11	BG 00-7-30-1-1	+	s	–	–	–	l	–	–	–	–	–	–	–	–
T11	BG 00-7-30-1-2	+	w	–	–	–	w	–	–	–	–	–	–	–	–
T11	BG 00-7-30-1-C	+	+	–	–	–	s	–	–	–	–	–	–	–	–
T11	BG 00-8-15-1-1	+	l	–	–	–	l	–	–	–	–	–	–	–	–
N1	BG 98-8-14-1-2-1	+	l	–	–	+	l	–	–	w	–	+	l	–	–
N1	BG 98-8-14-1-3-3	w	w	–	–	+	+	–	–	w	–	+	+	–	–
N1	BG 98-8-14-1-4-3	+	l	–	–	+	w	–	–	–	–	+	s	–	–
N2	BG 98-8-14-1-3-1	+	+	–	–	+	–	–	–	–	–	l	–	–	–
N3	BG 98-8-14-1-3-2	+	–	–	–	l	–	l	–	–	–	l	l	–	–
N3	BG 98-8-14-1-4-2	+	+	s	–	+	–	+	–	+	–	+	w	–	–
N4	BG 98-8-14-1-4-1	+	+	+	–	+	+	–	–	+	+	+	–	–	–
C1	BG 98-12-9-2-1	w	–	–	–	–	–	–	–	–	–	–	–	–	–
C1	BG 98-12-9-2-2-1	w	–	–	–	–	–	–	–	–	–	–	–	–	–
C1	BG 98-12-9-2-2-2	–	–	–	–	–	–	–	–	–	–	–	–	–	–

[a] Abbreviations: Glu, D-glucose; Gal, D-galactose; Mal, Maltose; αGl, α-methyl-D-glucoside; Suc, Sucrose; Tre, α-α-trehalose; Mel, melibose; Lac, Lactose; Cel, Cellobiose; Mel, Melezitose; Raf, Raffinose; Inu, Inulin; Sta, Starch; Xyl, Xylose
Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; –, negative; N, no data

Table 5 (continued). Results of the *Fermentation of Carbohydrates Test.*

Grp	Isolate Number	Carbohydrate[a]													
		Glu	Gal	Mal	αGl	Suc	Tre	Mel	Lac	Cel	Mel	Raf	Inu	Sta	Xyl
C2	BG 99-2-5-7-1-1	+	–	–	–	–	s	–	–	–	–	–	–	–	–
C2	BG 99-2-5-7-1-2	+	–	–	–	–	l	–	–	–	–	–	–	–	–
C2	BG 99-2-5-7-1-3	+	–	–	–	–	w	–	–	–	–	–	–	–	–
S1	BG 98-8-5-1-1	+	l	–	–	+	l	–	–	–	–	l	s	–	–
M1	BG 99-11-14-1-4-1	–	–	–	–	–	w	–	–	–	–	–	–	–	–
M2	BG 99-11-14-1-4-2	+	l	–	–	–	l	–	–	–	–	–	–	–	–
D1	BG 99-11-14-5-2-1	+	–	–	–	–	w	–	–	–	–	–	–	–	–
D1	BG 99-11-14-8-2-1	+	–	–	–	–	–	–	–	–	–	–	–	–	–
D1	BG 99-11-14-8-3-1	w	–	–	–	–	–	–	–	–	–	–	–	–	–
D2	BG 99-11-14-7-C	w	–	–	–	–	+	–	–	–	–	–	–	–	–

[a] Abbreviations: Glu, D-glucose; Gal, D-galactose; Mal, Maltose; αGl, α-methyl-D-glucoside; Suc, Sucrose; Tre, α-α-trehalose; Mel, melibose; Lac, Lactose; Cel, Cellobiose; Mel, Melezitose; Raf, Raffinose; Inu, Inulin; Sta, Starch; Xyl, Xylose
Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; -, negative; N, no data

Table 6. Results of the *Assimilation Tests of Carbon Compounds.*

Grp	Isolate Number	Carbon Substrates[a]													
		Glu	Gal	Sor	Glc	Rib	Xyl	L-Ara	D-Ara	Rha	Suc	Mal	Tre	αGl	Cel
E1	BG 98-8-25-1-2	+	+	-	l	l	w	-	-	-	+	+	+	+	+
E1	BG 98-8-25-1-4	+	+	-	l	l	l	-	-	-	+	+	+	+	+
E1	BG 98-8-25-1-5	+	+	-	l	l	l	-	-	-	+	+	+	+	+
E1	BG 98-9-24-2-1	+	+	-	l	l	s	-	-	-	+	+	+	+	+
E2	BG 99-6-12-1-1	+	+	-	l	-	w	-	-	-	+	+	+	+	+
E3	BG 99-8-11-1-1	+	+	-	+	-	s	-	-	-	-	-	+	-	+
E3	BG 99-8-11-1-2-1	+	+	-	+	s	+	-	-	-	-	-	+	-	+
E3	BG 99-8-11-1-2-3	+	+	-	+	-	+	-	-	-	-	-	+	-	+
E3	BG 99-8-11-1-3	+	+	-	+	-	w	-	-	-	-	-	+	-	+
E4	BG 99-8-11-1-2-2	+	-	-	+	s	s	-	s	-	+	+	+	+	+
E4	BG 99-8-11-1-2-4	+	-	-	+	-	+	-	s	-	+	+	+	+	+
E4	BG 00-6-14-1-1	+	+	w	+	-	+	-	l	-	+	+	+	+	+
E4	BG 00-6-14-1-2	+	+	-	+	-	s	-	l	-	+	+	+	+	+
E4	BG 00-6-14-1-3	+	+	-	+	-	l	-	l	-	+	+	+	+	+
E4	BG 00-6-14-2-1	+	+	-	+	-	l	-	w	-	+	+	+	+	+
E4	BG 00-6-14-2-2	+	+	-	+	w	+	-	s	-	+	+	+	+	+
E4	BG 00-6-14-2-3	+	+	-	+	-	+	-	w	-	+	+	+	+	+
E5	BG 99-8-11-1-4-1	+	+	+	-	s	+	+	-	+	+	+	+	+	+
E6	BG 99-8-11-1-4-2	+	+	-	+	s	+	-	s	-	+	+	+	+	+
E7	BG 99-8-11-1-C1	+	+	-	+	+	s	-	s	-	+	+	+	+	+
E8	BG 99-8-11-1-C2	+	+	-	+	+	+	s	-	-	+	+	+	+	+
E9	BG 99-11-14-10-1-1	+	+	-	w	-	+	-	-	-	+	+	+	+	+
E9	BG 99-11-14-10-2-1	+	+	-	w	-	+	-	-	-	+	+	+	+	+
E9	BG 99-11-14-10-3-1	+	+	-	w	-	+	-	-	-	+	+	+	+	+
E9	BG 99-11-14-10-3-2	+	+	-	w	-	+	-	-	-	+	+	+	+	+
E9	BG 99-11-14-11-1-1	+	+	-	l	-	+	-	-	-	+	+	+	+	+

[a] Abbreviations: Glu, D-glucose; Gal, D-galactose; Sor, L-sorbose; Glc, D-glucosamine; Rib, D-ribose; Xyl, D-xylose; L-Ara, L- arabinose; D-Ara, D-arabinose; Rha, L-rhaminose; Suc, sucrose; Mal, maltose; Tre, α-α-trehalose; αGl, α-methyl-D-glucoside; Cel, cellobiose

Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; -, negative; N, no data

Table 6 (continued). Results of the *Assimilation Tests of Carbon Compounds.*

Grp	Isolate Number	Carbon Substrates[a]													
		Glu	Gal	Sor	Glc	Rib	Xyl	L-Ara	D-Ara	Rha	Suc	Mal	Tre	αGl	Cel
E9	BG 99-11-14-11-4-1	+	+	-	l	-	+	-	-	-	+	+	+	+	+
E9	BG 99-11-14-11-5-1	+	+	-	w	-	+	-	-	-	+	+	+	+	+
E10	BG 99-11-14-10-4-1	+	-	-	-	-	+	-	-	-	+	+	+	+	+
E12	BG 00-8-15-4-1	+	+	-	+	+	w	-	w	-	+	+	+	+	+
T1	BG 98-8-18-2	+	+	+	+	s	+	-	s	-	-	-	+	-	+
T1	BG 98-12-9-1-1	+	+	+	+	s	w	-	+	-	-	-	+	-	+
T1	BG 98-12-9-1-3	+	+	s	+	s	+	-	+	-	-	-	+	-	+
T1	BG 99-2-5-2-1-1	+	+	+	+	+	+	-	+	-	-	-	+	-	+
T1	BG 99-2-5-2-1-2	+	+	+	+	+	+	-	+	-	-	-	+	-	+
T1	BG 99-3-22-1-1	+	+	+	l	+	+	-	+	-	-	-	+	-	+
T1	BG 99-3-22-1-2	+	+	+	+	+	+	-	+	-	-	-	+	-	+
T1	BG 99-3-22-1-3	+	+	+	+	s	+	-	+	-	w	-	+	-	+
T1	BG 99-3-22-1-4	+	+	+	+	+	+	-	+	-	-	-	+	-	+
T1	BG 99-9-28-1-4	+	+	+	+	+	+	-	+	-	w	-	+	-	+
T1	BG 00-6-7-1-1	+	+	+	+	-	+	-	l	-	-	-	+	-	+
T1	BG 00-6-7-1-2	+	+	+	+	s	+	-	+	-	w	-	+	-	+
T2	BG 98-12-9-1-2	+	+	+	+	s	+	+	+	l	+	+	+	+	+
T3	BG 98-9-24-3-1	+	+	w	+	-	l	+	s	+	+	+	+	+	+
T3	BG 98-9-24-3-2	+	+	w	l	-	l	+	s	+	l	+	+	+	+
T4	BG 98-9-2-2-4	+	+	w	+	s	+	-	s	-	+	+	+	+	+
T4	BG 00-6-23-2-1	+	+	w	w	w	+	-	w	-	+	+	+	+	+
T4	BG 00-6-23-2-2	+	+	w	-	s	+	-	-	-	+	+	+	+	+
T4	BG 00-6-26-1-2-1	+	+	w	+	-	+	-	s	-	+	+	+	+	+
T4	BG 00-6-26-1-2-2	+	+	+	+	s	+	-	+	-	+	+	+	+	+
T4	BG 00-6-26-1-2-3	+	+	+	+	w	+	-	w	-	+	+	+	+	+
T4	BG 00-7-5-1-2-2	+	+	-	+	w	+	-	w	-	+	+	+	+	+
T4	BG 00-7-5-1-3-1	+	+	-	+	w	l	-	s	-	+	+	+	+	+
T4	BG 00-7-5-1-3-2	+	+	+	+	s	+	-	w	-	+	+	+	+	+

[a] Abbreviations: Glu, D-glucose; Gal, D-galactose; Sor, L-sorbose; Glc, D-glucosamine; Rib, D-ribose; Xyl, D-xylose; L-Ara, L- arabinose; D-Ara, D-arabinose; Rha, L-rhaminose; Suc, sucrose; Mal, maltose; Tre, α-α-trehalose; αGl, α-methyl-D-glucoside; Cel, cellobiose

Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; -, negative; N, no data

Table 6 (continued). Results of the *Assimilation Tests of Carbon Compounds.*

Grp	Isolate Number	Carbon Substrates[a]													
		Glu	Gal	Sor	Glc	Rib	Xyl	L-Ara	D-Ara	Rha	Suc	Mal	Tre	αGl	Cel
T4	BG 00-7-5-1-4-1	+	+	+	+	w	+	-	w	-	+	+	+	+	+
T4	BG 00-7-5-1-4-2	+	+	+	+	w	l	-	s	-	+	+	+	+	+
T4	BG 00-6-23-1-1	+	+	s	w	+	+	-	w	-	+	+	+	+	+
T4	BG 00-6-23-1-2	+	+	w	w	s	+	-	w	-	+	+	+	+	+
T4	BG 00-6-23-1-3	+	+	+	+	w	+	-	s	-	+	+	+	+	+
T5	BG 99-8-18-1-1	+	+	-	+	w	l	-	l	-	+	+	+	+	+
T6	BG 99-8-18-1-3-1	+	w	l	-	-	w	-	-	-	-	-	-	-	-
T6	BG 99-8-18-1-3-2	+	l	l	-	-	w	-	-	-	-	-	-	-	-
T6	BG 99-8-18-1-6	+	l	l	-	-	s	-	-	-	-	-	-	-	-
T7	BG 99-8-18-1-4-1	+	+	w	+	+	+	w	-	-	+	+	+	+	+
T7	BG 99-8-18-1-4-2	+	+	w	+	+	+	+	-	-	+	+	+	+	+
T9	BG 00-7-5-1-2-1	+	+	+	+	w	+	w	s	-	-	+	+	-	+
T9	BG 00-7-5-1-2-3	+	+	+	+	w	+	l	s	-	-	+	+	-	+
T10	BG 00-6-26-2-2-1	+	+	+	+	w	+	-	l	w	+	+	+	w	+
T11	BG 00-7-30-1-1	+	+	w	+	s	s	-	-	-	-	-	+	-	+
T11	BG 00-7-30-1-2	+	+	-	+	l	+	-	-	-	-	-	+	-	+
T11	BG 00-7-30-1-C	+	+	s	+	+	l	-	-	-	-	-	+	-	+
T11	BG 00-8-15-1-1	+	+	w	+	+	s	-	-	-	-	-	+	-	+
N1	BG 98-8-14-1-2-1	+	+	+	+	+	l	+	+	-	+	+	+	+	+
N1	BG 98-8-14-1-3-3	+	+	+	+	+	+	+	+	-	+	+	+	+	+
N1	BG 98-8-14-1-4-3	+	+	l	l	s	+	s	+	-	+	+	+	+	+
N2	BG 98-8-14-1-3-1	+	+	+	+	w	-	-	-	-	+	+	+	+	+
N3	BG 98-8-14-1-3-2	+	+	+	s	+	+	+	-	+	+	+	+	+	+
N3	BG 98-8-14-1-4-2	+	+	+	l	+	+	s	-	+	+	+	+	+	+

[a] Abbreviations: Glu, D-glucose; Gal, D-galactose; Sor, L-sorbose; Glc, D-glucosamine; Rib, D-ribose; Xyl, D-xylose; L-Ara, L- arabinose; D-Ara, D-arabinose; Rha, L-rhaminose; Suc, sucrose; Mal, maltose; Tre, α-α-trehalose; αGl, α-methyl-D-glucoside; Cel, cellobiose

Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; -, negative; N, no data

Table 6 (continued). Results of the *Assimilation Tests of Carbon Compounds.*

Grp	Isolate Number	Carbon Substrates[a]													
		Glu	Gal	Sor	Glc	Rib	Xyl	L-Ara	D-Ara	Rha	Suc	Mal	Tre	αGl	Cel
N4	BG 98-8-14-1-4-1	+	+	+	+	w	+	+	–	+	+	+	+	+	+
C1	BG 98-12-9-2-1 +	+	+	l	s	+	+	+	w	+	+	+	w	+	
C1	BG 98-12-9-2-2-1	+	+	+	+	s	+	+	+	w	s	+	+	w	+
C1	BG 98-12-9-2-2-2	+	+	+	+	l	+	+	+	–	l	+	+	s	+
C2	BG 99-2-5-7-1-1	+	+	+	+	w	w	w	+	–	w	–	+	–	+
C2	BG 99-2-5-7-1-2	+	+	s	s	w	w	w	s	–	–	–	+	–	+
C2	BG 99-2-5-7-1-3	+	+	s	l	–	–	w	w	–	–	–	+	–	+
S1	BG 98-8-5-1-1	+	+	+	+	+	+	+	+	–	+	+	+	+	+
M2	BG 99-11-14-1-4-2	+	+	–	+	+	–	–	–	–	+	+	+	+	+
D1	BG 99-11-14-5-2-1	+	–	–	+	+	–	–	–	–	+	+	+	+	+
D1	BG 99-11-14-8-2-1	+	–	–	+	s	–	–	–	–	+	+	+	l	+
D1	BG 99-11-14-8-3-1	+	–	–	+	l	–	–	–	–	+	+	+	+	+
D2	BG 99-11-14-7-C	+	–	–	l	–	–	–	–	–	+	+	+	–	–

[a] Abbreviations: Glu, D-glucose; Gal, D-galactose; Sor, L-sorbose; Glc, D-glucosamine; Rib, D-ribose; Xyl, D-xylose; L-Ara, L- arabinose; D-Ara, D-arabinose; Rha, L-rhaminose; Suc, sucrose; Mal, maltose; Tre, α-α-trehalose; αGl, α-methyl-D-glucoside; Cel, cellobiose

Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; –, negative; N, no data

Table 6 (continued). Results of the *Assimilation Tests of Carbon Compounds.*

Grp	Isolate Number	Carbon Substrates[a]													
		Sal	Arb	Mel	Lac	Raf	Mlz	Inu	Sta	Gly	Ery	Rib	Xyl	Ara	Glu
E1	BG 98-8-25-1-2	+	+	–	–	–	+	–	w	+	–	+	s	–	+
E1	BG 98-8-25-1-4	+	+	–	–	–	+	–	w	+	–	+	+	–	+
E1	BG 98-8-25-1-5	+	+	–	–	–	+	–	w	+	–	+	+	–	+
E1	BG 98-9-24-2-1	+	+	–	–	–	+	–	w	+	–	+	–	–	+
E2	BG 99-6-12-1-1	+	+	–	–	–	+	–	–	+	–	+	s	–	l
E3	BG 99-8-11-1-1	+	+	–	–	–	–	–	–	+	+	+	+	–	+
E3	BG 99-8-11-1-2-1	+	+	–	–	–	–	–	–	+	+	+	+	–	+
E3	BG 99-8-11-1-2-3	+	+	–	–	–	–	–	–	+	+	+	+	–	+
E3	BG 99-8-11-1-3	+	+	–	–	–	–	–	–	+	+	+	+	–	–
E4	BG 99-8-11-1-2-2	+	+	–	–	–	+	–	–	+	+	+	+	–	+
E4	BG 99-8-11-1-2-4	+	+	–	–	–	+	–	–	+	+	+	+	–	+
E4	BG 00-6-14-1-1	+	+	–	–	–	+	–	–	+	+	+	+	–	+
E4	BG 00-6-14-1-2	+	+	–	–	–	+	–	–	+	+	+	+	–	+
E4	BG 00-6-14-1-3	+	+	–	–	–	+	–	–	+	+	+	+	–	+
E4	BG 00-6-14-2-1	+	+	–	–	–	+	–	–	+	+	+	l	–	+
E4	BG 00-6-14-2-2	+	+	–	–	–	+	–	–	+	+	+	+	–	+
E4	BG 00-6-14-2-3	+	+	–	–	–	+	–	–	+	+	+	+	–	+
E5	BG 99-8-11-1-4-1	+	+	+	+	+	+	w	–	+	+	+	+	+	+
E6	BG 99-8-11-1-4-2	+	+	–	–	–	+	–	–	+	+	+	+	–	+
E7	BG 99-8-11-1-C1	+	+	–	–	–	–	–	–	+	–	+	+	s	+
E8	BG 99-8-11-1-C2	+	+	–	–	–	+	–	–	+	+	+	+	+	+
E9	BG 99-11-14-10-1-1	+	+	–	–	–	+	–	–	+	–	s	–	–	+
E9	BG 99-11-14-10-2-1	+	+	–	–	–	w	–	–	+	–	+	–	–	+
E9	BG 99-11-14-10-3-1	+	+	–	–	–	s	–	–	+	–	+	w	–	+
E9	BG 99-11-14-10-3-2	+	+	–	–	–	l	–	–	+	–	l	w	–	+
E9	BG 99-11-14-11-1-1	+	+	–	–	–	+	–	–	+	–	+	–	–	+
E9	BG 99-11-14-11-4-1	+	+	–	–	–	+	–	–	+	–	+	–	–	+
E9	BG 99-11-14-11-5-1	+	+	–	–	–	s	–	–	+	–	+	–	–	+

[a] Abbreviations: Sal, salicin; Arb, arbutin; Mel, melibiose; Lac, lactose; Raf, raffinose; Mlz, melezitose; Inu, inulin; Sta, starch (soluble); Gly, glycerol; Ery, erythritol; Rib, ribitol; Xyl, xylitol; Ara, L-arabinitol; Glu, D-glucitol
Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; –, negative; N, no data

Table 6 (continued). Results of the *Assimilation Tests of Carbon Compounds.*

Grp	Isolate Number	Carbon Substrates[a]													
		Sal	Arb	Mel	Lac	Raf	Mlz	Inu	Sta	Gly	Ery	Rib	Xyl	Ara	Glu
E10	BG 99-11-14-10-4-1	+	+	-	-	-	+	-	-	+	-	+	+	-	+
E12	BG 00-8-15-4-1	s	+	-	w	-	s	-	-	+	-	+	+	-	+
T1	BG 98-8-18-2	+	+	-	-	-	-	-	-	+	+	+	w	w	+
T1	BG 98-12-9-1-1	+	+	-	-	-	-	-	-	+	+	+	w	w	+
T1	BG 98-12-9-1-3	+	+	-	-	-	-	-	-	+	+	+	w	w	+
T1	BG 99-2-5-2-1-1	+	+	-	-	-	-	-	-	+	+	+	s	-	+
T1	BG 99-2-5-2-1-2	+	+	-	-	-	-	-	-	+	+	+	w	-	+
T1	BG 99-3-22-1-1	+	+	-	-	-	-	-	-	+	+	+	w	w	+
T1	BG 99-3-22-1-2	+	+	-	-	-	-	-	-	+	+	+	w	-	+
T1	BG 99-3-22-1-3	+	+	-	-	-	-	-	-	+	+	+	s	s	+
T1	BG 99-3-22-1-4	+	+	-	-	-	-	-	-	+	+	+	w	w	+
T1	BG 99-9-28-1-4	+	+	-	-	-	-	-	-	+	+	+	+	+	+
T1	BG 00-6-7-1-1	+	+	-	-	-	-	-	-	+	+	+	w	-	+
T1	BG 00-6-7-1-2	+	+	-	-	-	-	-	-	+	+	+	s	-	+
T2	BG 98-12-9-1-2	+	l	+	+	+	+	-	w	w	w	w	+	s	+
T3	BG 98-9-24-3-1	s	w	-	s	-	+	-	-	-	-	-	-	-	w
T3	BG 98-9-24-3-2	s	w	-	s	-	l	-	-	-	-	-	-	-	w
T4	BG 98-9-2-2-4	+	+	-	-	-	+	-	-	+	+	+	+	w	+
T4	BG 00-6-23-2-1	+	+	-	-	-	+	-	-	+	+	+	+	w	+
T4	BG 00-6-23-2-2	+	+	-	-	-	+	-	-	+	+	+	+	-	+
T4	BG 00-6-26-1-2-1	+	+	-	-	-	+	-	-	+	+	+	+	-	+
T4	BG 00-6-26-1-2-2	+	+	-	-	-	+	-	-	+	+	+	+	-	+
T4	BG 00-6-26-1-2-3	+	+	-	-	-	+	-	-	+	+	+	+	-	+
T4	BG 00-7-5-1-2-2	+	+	-	-	-	+	-	-	+	+	+	+	-	+
T4	BG 00-7-5-1-3-1	+	+	-	-	-	+	-	-	+	+	+	+	-	+
T4	BG 00-7-5-1-3-2	+	+	-	-	-	+	-	-	+	+	+	+	w	+
T4	BG 00-7-5-1-4-1	+	+	-	-	-	+	-	-	+	+	+	+	-	+
T4	BG 00-7-5-1-4-2	+	+	-	-	-	+	-	-	+	+	+	+	-	+
T4	BG 00-6-23-1-1	+	+	-	-	-	+	-	-	+	+	+	+	w	+
T4	BG 00-6-23-1-2	+	+	-	-	-	+	-	-	+	+	+	+	w	+
T4	BG 00-6-23-1-3	+	+	-	-	-	+	-	-	+	+	+	+	w	+

[a] Abbreviations: Sal, salicin; Arb, arbutin; Mel, melibiose; Lac, lactose; Raf, raffinose; Mlz, melezitose; Inu, inulin; Sta, starch (soluble); Gly, glycerol; Ery, erythritol; Rib, ribitol; Xyl, xylitol; Ara, L-arabinitol; Glu, D-glucitol
Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; -, negative; N, no data

Table 6 (continued). Results of the *Assimilation Tests of Carbon Compounds.*

Grp	Isolate Number	Carbon Substrates[a]													
		Sal	Arb	Mel	Lac	Raf	Mlz	Inu	Sta	Gly	Ery	Rib	Xyl	Ara	Glu
T5	BG 99-8-18-1-1	+	+	-	-	-	+	-	-	+	+	+	+	w	+
T6	BG 99-8-18-1-3-1	-	-	-	-	-	-	-	-	+	-	+	s	-	+
T6	BG 99-8-18-1-3-2	-	-	-	-	-	-	-	-	+	-	+	l	-	+
T6	BG 99-8-18-1-6	-	-	-	-	-	-	-	-	+	-	+	s	-	+
T7	BG 99-8-18-1-4-1	+	+	-	-	-	+	-	-	+	+	+	+	+	+
T7	BG 99-8-18-1-4-2	+	+	-	-	-	+	-	-	+	+	+	l	+	+
T9	BG 00-7-5-1-2-1	-	-	-	-	-	-	-	-	s	+	+	l	-	+
T9	BG 00-7-5-1-2-3	-	-	-	-	-	-	-	-	s	+	+	l	-	+
T10	BG 00-6-26-2-2-1	s	+	l	w	-	+	-	s	l	+	s	w	-	+
T11	BG 00-7-30-1-1	+	+	-	-	-	-	-	-	+	+	+	w	-	+
T11	BG 00-7-30-1-2	+	+	-	-	-	-	-	-	+	+	+	+	-	+
T11	BG 00-7-30-1-C	+	+	-	-	-	-	-	-	+	+	+	+	-	+
T11	BG 00-8-15-1-1	+	+	-	-	-	-	-	-	+	+	+	+	-	+
N1	BG 98-8-14-1-2-1	+	+	+	-	+	+	+	-	+	-	+	+	+	+
N1	BG 98-8-14-1-3-3	+	+	+	-	+	+	+	-	+	-	+	+	+	+
N1	BG 98-8-14-1-4-3	+	+	+	-	+	+	+	-	+	-	+	+	+	+
N2	BG 98-8-14-1-3-1	+	+	-	-	+	-	s	w	+	-	+	-	-	+
N3	BG 98-8-14-1-3-2	+	+	+	+	+	+	s	-	+	+	+	+	+	+
N3	BG 98-8-14-1-4-2	+	+	+	+	+	+	+	-	+	+	+	+	+	+
N4	BG 98-8-14-1-4-1	+	+	-	-	+	+	-	+	+	-	+	+	w	+
C1	BG 98-12-9-2-1	s	+	+	+	w	w	w	-	s	+	+	+	+	+
C1	BG 98-12-9-2-2-1	s	+	+	+	w	w	w	w	s	+	+	+	+	+
C1	BG 98-12-9-2-2-2	l	+	+	+	w	w	-	-	s	+	+	+	+	+
C2	BG 99-2-5-7-1-1	+	+	-	-	-	-	-	-	+	+	+	l	w	+
C2	BG 99-2-5-7-1-2	+	+	-	-	-	-	-	-	+	+	+	w	l	+
C2	BG 99-2-5-7-1-3	+	+	-	-	-	-	-	-	+	+	+	+	-	+

[a] Abbreviations: Sal, salicin; Arb, arbutin; Mel, melibiose; Lac, lactose; Raf, raffinose; Mlz, melezitose; Inu, inulin; Sta, starch (soluble); Gly, glycerol; Ery, erythritol; Rib, ribitol; Xyl, xylitol; Ara, L-arabinitol; Glu, D-glucitol
Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; -, negative; N, no data

Table 6 (continued). Results of the *Assimilation Tests of Carbon Compounds.*

Grp	Isolate Number	Carbon Substrates[a]													
		Sal	Arb	Mel	Lac	Raf	Mlz	Inu	Sta	Gly	Ery	Rib	Xyl	Ara	Glu
S1	BG 98-8-5-1-1	+	+	+	-	+	+	+	-	+	-	+	+	+	+
M2	BG 99-11-14-1-4-2	+	+	-	-	-	+	-	-	+	-	+	w	-	+
D1	BG 99-11-14-5-2-1	l	+	-	-	-	-	-	-	+	-	+	-	-	+
D1	BG 99-11-14-8-2-1	l	l	-	-	-	-	-	-	s	-	+	-	-	+
D1	BG 99-11-14-8-3-1	+	+	-	-	-	-	-	-	+	-	+	-	-	+
D2	BG 99-11-14-7-C	s	l	-	-	-	-	-	-	l	-	+	-	-	+

[a] Abbreviations: Sal, salicin; Arb, arbutin; Mel, melibiose; Lac, lactose; Raf, raffinose; Mlz, melezitose; Inu, inulin; Sta, starch (soluble); Gly, glycerol; Ery, erythritol; Rib, ribitol; Xyl, xylitol; Ara, L-arabinitol; Glu, D-glucitol
Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; -, negative; N, no data

Table 6 (continued). Results of the *Assimilation Tests of Carbon Compounds.*

Grp	Isolate Number	Carbon Substrates[a]													
		Man	Gal	Ino	Gluc	2-Ket	5-Ket	Gln	Glr	Glt	Lact	Succ	Cit	Met	Eth
E1	BG 98-8-25-1-2	+	–	–	l	+	N	l	–	N	w	+	+	–	+
E1	BG 98-8-25-1-4	+	–	–	l	+	N	l	–	N	w	+	+	–	+
E1	BG 98-8-25-1-5	+	–	–	l	+	N	+	–	N	s	+	+	–	+
E1	BG 98-9-24-2-1	+	–	–	l	+	N	w	–	N	w	+	+	–	+
E2	BG 99-6-12-1-1	+	–	–	l	+	N	w	–	N	–	+	+	–	+
E3	BG 99-8-11-1-1	+	–	–	+	+	N	w	–	N	–	+	+	–	+
E3	BG 99-8-11-1-2-1	+	–	–	w	+	N	l	–	N	–	+	+	–	+
E3	BG 99-8-11-1-2-3	+	–	–	+	+	N	w	–	N	–	+	+	–	+
E3	BG 99-8-11-1-3	+	–	–	+	+	N	w	–	N	–	+	+	–	+
E4	BG 99-8-11-1-2-2	+	–	–	+	+	N	+	–	N	–	+	l	–	+
E4	BG 99-8-11-1-2-4	+	–	–	+	+	N	+	–	N	–	+	+	–	+
E4	BG 00-6-14-1-1	+	–	–	+	+	N	+	–	N	–	+	+	–	+
E4	BG 00-6-14-1-2	+	–	–	+	+	N	+	–	N	–	+	+	–	+
E4	BG 00-6-14-1-3	+	–	–	+	+	N	+	–	N	–	+	+	–	+
E4	BG 00-6-14-2-1	+	–	–	+	+	N	+	–	N	–	+	+	–	+
E4	BG 00-6-14-2-2	+	–	–	l	+	N	+	–	N	–	+	+	–	+
E4	BG 00-6-14-2-3	+	–	–	l	+	N	+	–	N	–	+	s	–	+
E5	BG 99-8-11-1-4-1	+	–	–	w	+	N	+	+	N	s	+	+	–	+
E6	BG 99-8-11-1-4-2	+	–	–	+	+	N	+	–	N	–	+	+	–	+
E7	BG 99-8-11-1-C1	+	–	–	w	+	N	w	–	N	l	+	+	–	+
E8	BG 99-8-11-1-C2	+	–	–	+	+	N	w	–	N	–	+	+	–	+
E9	BG 99-11-14-10-1-1	+	–	–	l	+	N	–	–	N	–	+	l	–	w
E9	BG 99-11-14-10-2-1	+	–	–	w	+	N	w	–	N	–	+	+	–	+
E9	BG 99-11-14-10-3-1	+	–	–	s	+	N	s	–	N	–	+	+	–	+
E9	BG 99-11-14-10-3-2	+	–	–	l	+	N	w	–	N	–	+	w	–	–
E9	BG 99-11-14-11-1-1	+	–	–	w	+	N	w	–	N	–	+	+	–	+
E9	BG 99-11-14-11-4-1	+	–	–	w	+	N	s	–	N	–	+	+	–	+
E9	BG 99-11-14-11-5-1	+	–	–	l	+	N	w	–	N	–	+	+	–	+

[a] Abbreviations: Man, D-mannitol; Gal, galactitol; Ino, myo-inositol; Gluc, D-glucono-1,5-lactone; 2-Ket, 2-keto-D-gluconate; 5-Ket, 5-keto-D-gluconate; Gln, D-gluconate; Glr, D-glucuronate; Glt, D-galacturonic acid; Lact, DL-lactate; Succ, succinate; Cit, citrate; Met, methanol; Eth, ethanol

Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; –, negative; N, no data

Table 6 (continued). Results of the *Assimilation Tests of Carbon Compounds.*

Grp	Isolate Number	Carbon Substrates[a]													
		Man	Gal	Ino	Gluc	2-Ket	5-Ket	Gln	Glr	Glt	Lact	Succ	Cit	Met	Eth
E10	BG 99-11-14-10-4-1	+	-	-	s	-	N	+	-	N	+	+	+	-	s
E12	BG 00-8-15-4-1	+	-	-	w	+	N	-	-	N	s	+	w	-	+
T1	BG 98-8-18-2	+	-	-	s	+	N	w	-	N	-	+	+	-	+
T1	BG 98-12-9-1-1	+	-	-	l	+	N	w	-	N	-	+	+	-	+
T1	BG 98-12-9-1-3	+	-	-	l	+	N	w	-	N	-	+	+	-	+
T1	BG 99-2-5-2-1-1	+	-	-	+	+	N	l	-	N	-	+	+	-	+
T1	BG 99-2-5-2-1-2	+	-	-	+	+	N	-	-	N	-	+	+	-	+
T1	BG 99-3-22-1-1	+	-	-	+	+	N	w	-	N	-	+	+	-	+
T1	BG 99-3-22-1-2	+	-	-	+	+	N	w		N	-	+	+	-	+
T1	BG 99-3-22-1-3	+	-	-	+	+	N	l	-	N	-	+	+	-	+
T1	BG 99-3-22-1-4	+	-	-	+	+	N	w	-	N	-	+	+	-	+
T1	BG 99-9-28-1-4	+	-	-	+	+	N	w	-	N	-	+	+	-	+
T1	BG 00-6-7-1-1	+	-	-	+	+	N	-	-	N	-	+	+	-	+
T1	BG 00-6-7-1-2	+	-	-	+	+	N	w	-	N	-	+	+	-	+
T2	BG 98-12-9-1-2	+	s	l	+	+	N	+	l	N	w	+	l	-	s
T3	BG 98-9-24-3-1	-	-	+	+	+	N	+	l	N	w	+	+	-	-
T3	BG 98-9-24-3-2	-	-	l	+	+	N	+	l	N	w	l	l	-	-
T4	BG 98-9-2-2-4	+	-	-	+	+	N	+	-	N	-	+	+	-	+
T4	BG 00-6-23-2-1	+	-	-	+	+	N	+	-	N	-	+	+	-	+
T4	BG 00-6-23-2-2	+	-	-	+	+	N	+	-	N	-	+	l	-	+
T4	BG 00-6-26-1-2-1	+	-	-	+	+	N	+	-	N	-	+	l	-	+
T4	BG 00-6-26-1-2-2	+	-	-	+	+	N	+	-	N	-	+	+	-	+
T4	BG 00-6-26-1-2-3	+	-	-	+	+	N	+	-	N	-	+	l	-	+
T4	BG 00-7-5-1-2-2	+	-	-	+	+	N	+	-	N	-	+	+	-	+
T4	BG 00-7-5-1-3-1	+	-	-	+	+	N	+	-	N	-	+	l	-	+
T4	BG 00-7-5-1-3-2	+	-	-	+	+	N	+	-	N	-	+	+	-	+
T4	BG 00-7-5-1-4-1	+	-	-	+	+	N	+	-	N	-	+	+	-	+
T4	BG 00-7-5-1-4-2	+	-	-	+	+	N	+	-	N	-	+	+	-	+
T4	BG 00-6-23-1-1	+	-	-	+	+	N	+	-	N	-	+	+	-	+
T4	BG 00-6-23-1-2	+	-	-	+	+	N	+	-	N	-	+	+	-	+
T4	BG 00-6-23-1-3	+	-	-	+	+	N	+	-	N	-	+	+	-	+

[a] Abbreviations: Man, D-mannitol; Gal, galactitol; Ino, myo-inositol; Gluc, D-glucono-1,5-lactone; 2-Ket, 2-keto-D-gluconate; 5-Ket, 5-keto-D-gluconate; Gln, D-gluconate; Glr, D-glucuronate; Glt, D-galacturonic acid; Lact, DL-lactate; Succ, succinate; Cit, citrate; Met, methanol; Eth, ethanol

Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; -, negative; N, no data

Table 6 (continued). Results of the *Assimilation Tests of Carbon Compounds.*

Grp	Isolate Number	Carbon Substrates[a]													
		Man	Gal	Ino	Gluc	2-Ket	5-Ket	Gln	Glr	Glt	Lact	Succ	Cit	Met	Eth
T5	BG 99-8-18-1-1	+	–	–	+	+	N	+	–	N	w	+	+	–	+
T6	BG 99-8-18-1-3-1	+	–	–	–	–	N	w	–	N	–	+	w	–	–
T6	BG 99-8-18-1-3-2	+	–	–	s	–	N	s	–	N	–	+	w	–	–
T6	BG 99-8-18-1-6	+	–	–	s	–	N	w	–	N	–	+	w	–	–
T7	BG 99-8-18-1-4-1	+	–	–	+	+	N	l	–	N	–	+	+	–	+
T7	BG 99-8-18-1-4-2	+	–	–	+	+	N	w	–	N	–	+	+	–	+
T9	BG 00-7-5-1-2-1	+	–	w	s	l	N	–	s	N	–	+	–	–	s
T9	BG 00-7-5-1-2-3	+	–	w	s	l	N	–	l	N	–	+	–	–	s
T10	BG 00-6-26-2-2-1	+	–	w	+	w	N	w	+	N	w	+	s	–	w
T11	BG 00-7-30-1-1	+	–	–	l	+	N	w	–	N	–	l	+	–	+
T11	BG 00-7-30-1-2	+	–	–	+	+	N	l	–	N	–	+	+	–	+
T11	BG 00-7-30-1-C	+	–	–	+	+	N	l	–	N	–	+	+	–	+
T11	BG 00-8-15-1-1	+	–	–	l	+	N	w	–	N	–	+	+	–	+
N1	BG 98-8-14-1-2-1	+	+	–	+	+	N	l	–	N	+	+	+	–	+
N1	BG 98-8-14-1-3-3	+	+	–	+	+	N	l	–	N	+	+	+	–	+
N1	BG 98-8-14-1-4-3	s	+	–	w	+	N	w	–	N	l	s	+	–	+
N2	BG 98-8-14-1-3-1	+	–	–	+	+	N	–	–	N	w	l	+	–	+
N3	BG 98-8-14-1-3-2	+	+	–	+	+	N	+	–	N	s	+	+	–	+
N3	BG 98-8-14-1-4-2	+	l	–	+	+	N	+	–	N	w	+	+	–	+
N4	BG 98-8-14-1-4-1	+	+	+	s	–	N	+	+	N	–	+	+	–	+
C1	BG 98-12-9-2-1	+	+	+	+	+	N	s	+	N	s	+	w	–	w
C1	BG 98-12-9-2-2-1	+	+	+	+	s	N	s	+	N	s	+	w	–	w
C1	BG 98-12-9-2-2-2	+	+	+	+	+	N	+	+	N	+	+	–	–	–

[a] Abbreviations: Man, D-mannitol; Gal, galactitol; Ino, myo-inositol; Gluc, D-glucono-1,5-lactone; 2-Ket, 2-keto-D-gluconate; 5-Ket, 5-keto-D-gluconate; Gln, D-gluconate; Glr, D-glucuronate; Glt, D-galacturonic acid; Lact, DL-lactate; Succ, succinate; Cit, citrate; Met, methanol; Eth, ethanol

Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; –, negative; N, no data

Table 6 (continued). Results of the *Assimilation Tests of Carbon Compounds.*

Grp	Isolate Number	Carbon Substrates[a]													
		Man	Gal	Ino	Gluc	2-Ket	5-Ket	Gln	Glr	Glt	Lact	Succ	Cit	Met	Eth
C2	BG 99-2-5-7-1-1	+	-	-	+	+	N	w	w	N	w	+	+	-	+
C2	BG 99-2-5-7-1-2	+	-	-	+	+	N	+	-	N	-	+	+	-	+
C2	BG 99-2-5-7-1-3	+	-	-	+	+	N	w	-	N	-	+	l	-	+
S1	BG 98-8-5-1-1	+	+	-	+	+	N	+	-	N	+	+	+	-	+
M2	BG 99-11-14-1-4-2	+	-	-	+	+	N	+	-	N	-	+	+	-	+
D1	BG 99-11-14-5-2-1	+	-	-	s	+	N	-	-	N	-	+	+	-	+
D1	BG 99-11-14-8-2-1	+	-	-	w	+	N	-	-	N	-	+	l	-	l
D1	BG 99-11-14-8-3-1	+	-	-	l	+	N	-	-	N	-	+	l	-	l
D2	BG 99-11-14-7-C	+	-	-	l	+	N	w	-	N	-	s	s	-	s

[a] Abbreviations: Man, D-mannitol; Gal, galactitol; Ino, myo-inositol; Gluc, D-glucono-1,5-lactone; 2-Ket, 2-keto-D-gluconate; 5-Ket, 5-keto-D-gluconate; Gln, D-gluconate; Glr, D-glucuronate; Glt, D-galacturonic acid; Lact, DL-lactate; Succ, succinate; Cit, citrate; Met, methanol; Eth, ethanol

Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; -, negative; N, no data

Table 6 (continued). Results of the *Assimilation Tests of Carbon Compounds.*

Grp	Isolate Number	Carbon Substrates[a]				
		Pro	But	Qui	Gl	Ga
E1	BG 98-8-25-1-2	-	-	-	-	-
E1	BG 98-8-25-1-4	-	-	-	-	-
E1	BG 98-8-25-1-5	-	-	-	-	-
E1	BG 98-9-24-2-1	-	-	-	-	-
E2	BG 99-6-12-1-1	-	-	-	-	-
E3	BG 99-8-11-1-1	-	-	-	-	-
E3	BG 99-8-11-1-2-1	-	-	-	-	-
E3	BG 99-8-11-1-2-3	-	-	-	-	-
E3	BG 99-8-11-1-3	-	-	-	-	-
E4	BG 99-8-11-1-2-2	-	-	-	-	-
E4	BG 99-8-11-1-2-4	-	-	-	-	-
E4	BG 00-6-14-1-1	w	-	-	-	-
E4	BG 00-6-14-1-2	w	-	-	-	-
E4	BG 00-6-14-1-3	w	-	-	-	-
E4	BG 00-6-14-2-1	-	-	-	-	-
E4	BG 00-6-14-2-2	w	-	-	-	-
E4	BG 00-6-14-2-3	-	-	-	-	-
E5	BG 99-8-11-1-4-1	+	w	+	-	-
E6	BG 99-8-11-1-4-2	-	-	-	-	-
E7	BG 99-8-11-1-C1	l	-	-	-	-
E8	BG 99-8-11-1-C2	-	-	-	-	-
E9	BG 99-11-14-10-1-1	-	-	-	-	-
E9	BG 99-11-14-10-2-1	-	-	-	-	-
E9	BG 99-11-14-10-3-1	-	-	-	-	-
E9	BG 99-11-14-10-3-2	-	-	-	-	-
E9	BG 99-11-14-11-1-1	-	-	-	-	-
E9	BG 99-11-14-11-4-1	-	-	-	-	-
E9	BG 99-11-14-11-5-1	-	-	-	-	-

[a] Abbreviations: Pro, propane-1,2-diol; But, butane-2,3-diol; Qui, quinic acid; Gl, D-glucarate; Ga, D-galactonate
Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; -, negative; N, no data

Table 6 (continued). Results of the *Assimilation Tests of Carbon Compounds.*

Grp	Isolate Number	Carbon Substrates[a]				
		Pro	But	Qui	Gl	Ga
E10	BG 99-11-14-10-4-1	+	+	-	-	-
E12	BG 00-8-15-4-1	-	-	-	-	-
T1	BG 98-8-18-2	-	-	-	-	-
T1	BG 98-12-9-1-1	-	-	-	-	-
T1	BG 98-12-9-1-3	-	-	-	-	-
T1	BG 99-2-5-2-1-1	-	-	-	-	-
T1	BG 99-2-5-2-1-2	-	-	-	-	-
T1	BG 99-3-22-1-1	-	-	-	-	-
T1	BG 99-3-22-1-2	-	-	-	-	-
T1	BG 99-3-22-1-3	-	-	-	-	-
T1	BG 99-3-22-1-4	-	-	-	-	-
T1	BG 99-9-28-1-4	-	-	-	-	-
T1	BG 00-6-7-1-1	-	-	-	-	-
T1	BG 00-6-7-1-2	-	-	-	-	-
T2	BG 98-12-9-1-2	-	-	+	l	w
T3	BG 98-9-24-3-1	-	-	-	+	s
T3	BG 98-9-24-3-2	-	-	-	l	w
T4	BG 98-9-2-2-4	-	-	-	-	-
T4	BG 00-6-23-2-1	-	-	-	-	-
T4	BG 00-6-23-2-2	-	-	-	-	-
T4	BG 00-6-26-1-2-1	w	-	-	-	-
T4	BG 00-6-26-1-2-2	w	-	-	-	-
T4	BG 00-6-26-1-2-3	w	-	-	-	-
T4	BG 00-7-5-1-2-2	w	-	-	-	-
T4	BG 00-7-5-1-3-1	w	-	-	-	-
T4	BG 00-7-5-1-3-2	w	-	-	-	-
T4	BG 00-7-5-1-4-1	w	-	-	-	-
T4	BG 00-7-5-1-4-2	w	-	-	-	-
T4	BG 00-6-23-1-1	w	-	-	-	-
T4	BG 00-6-23-1-2	-	-	-	-	-
T4	BG 00-6-23-1-3	w	-	-	-	-

[a] Abbreviations: Pro, propane-1,2-diol; But, butane-2,3-diol; Qui, quinic acid; Gl, D-glucarate; Ga, D-galactonate
Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; -, negative; N, no data

Table 6 (continued). Results of the *Assimilation Tests of Carbon Compounds.*

Grp	Isolate Number	Carbon Substrates[a]				
		Pro	But	Qui	Gl	Ga
T5	BG 99-8-18-1-1	w	-	-	-	l
T6	BG 99-8-18-1-3-1	-	-	-	-	w
T6	BG 99-8-18-1-3-2	-	-	-	-	l
T6	BG 99-8-18-1-6	-	-	-	-	-
T7	BG 99-8-18-1-4-1	-	-	-	-	s
T7	BG 99-8-18-1-4-2	-	-	-	-	s
T9	BG 00-7-5-1-2-1	w	-	-	-	-
T9	BG 00-7-5-1-2-3	w	-	-	-	-
T10	BG 00-6-26-2-2-1	w	w	w	w	l
T11	BG 00-7-30-1-1	-	-	-	-	-
T11	BG 00-7-30-1-2	-	-	-	-	-
T11	BG 00-7-30-1-C	-	-	-	-	-
T11	BG 00-8-15-1-1	-	-	-	-	-
N1	BG 98-8-14-1-2-1	l	-	-	-	-
N1	BG 98-8-14-1-3-3	+	-	-	-	-
N1	BG 98-8-14-1-4-3	w	-	-	-	-
N2	BG 98-8-14-1-3-1	w	-	-	-	-
N3	BG 98-8-14-1-3-2	+	-	+	-	-
N3	BG 98-8-14-1-4-2	+	-	+	-	-
N4	BG 98-8-14-1-4-1	w	-	-	-	-
C1	BG 98-12-9-2-1	s	w	w	w	w
C1	BG 98-12-9-2-2-1	s	w	w	w	w
C1	BG 98-12-9-2-2-2	s	-	-	-	-
C2	BG 99-2-5-7-1-1	w	-	-	-	w
C2	BG 99-2-5-7-1-2	-	-	-	-	-
C2	BG 99-2-5-7-1-3	w	-	-	-	-

[a] Abbreviations: Pro, propane-1,2-diol; But, butane-2,3-diol; Qui, quinic acid; Gl, D-glucarate; Ga, D-galactonate
Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; -, negative; N, no data

Table 6 (continued). Results of the *Assimilation Tests of Carbon Compounds.*

Grp	Isolate Number	Carbon Substrates[a]				
		Pro	But	Qui	Gl	Ga
S1	BG 98-8-5-1-1	+	-	-	-	-
M2	BG 99-11-14-1-4-2	-	-	-	-	-
D1	BG 99-11-14-5-2-1	w	w	-	-	-
D1	BG 99-11-14-8-2-1	w	-	-	-	-
D1	BG 99-11-14-8-3-1	w	-	-	-	-
D2	BG 99-11-14-7-C	-	-	-	-	-

[a] Abbreviations: Pro, propane-1,2-diol; But, butane-2,3-diol; Qui, quinic acid; Gl, D-glucarate; Ga, D-galactonate
Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; -, negative; N, no data

Table 7. Results of the *Formation of Extracellular Amyloid Compounds Test.*

Grp	Isolate Number	Result
E1	BG 98-8-25-1-2	-
E1	BG 98-8-25-1-4	-
E1	BG 98-8-25-1-5	-
E1	BG 98-9-24-2-1	-
E2	BG 99-6-12-1-1	-
E3	BG 99-8-11-1-1	-
E3	BG 99-8-11-1-2-1	-
E3	BG 99-8-11-1-2-3	-
E3	BG 99-8-11-1-3	-
E4	BG 99-8-11-1-2-2	-
E4	BG 99-8-11-1-2-4	-
E4	BG 00-6-14-1-1	-
E4	BG 00-6-14-1-2	-
E4	BG 00-6-14-1-3	-
E4	BG 00-6-14-2-1	-
E4	BG 00-6-14-2-2	-
E4	BG 00-6-14-2-3	-
E5	BG 99-8-11-1-4-1	-
E6	BG 99-8-11-1-4-2	-
E7	BG 99-8-11-1-C1	-
E8	BG 99-8-11-1-C2	-
E9	BG 99-11-14-10-1-1	-
E9	BG 99-11-14-10-2-1	-
E9	BG 99-11-14-10-3-1	-
E9	BG 99-11-14-10-3-2	-
E9	BG 99-11-14-11-1-1	-
E9	BG 99-11-14-11-4-1	-
E9	BG 99-11-14-11-5-1	-
E10	BG 99-11-14-10-4-1	-
E12	BG 00-8-15-4-1	-

Symbols: +, positive; -, negative; N, no data

Grp	Isolate Number	Result
T1	BG 98-8-18-2	-
T1	BG 98-12-9-1-1	-
T1	BG 98-12-9-1-3	-
T1	BG 99-2-5-2-1-1	-
T1	BG 99-2-5-2-1-2	-
T1	BG 99-3-22-1-1	-
T1	BG 99-3-22-1-2	-
T1	BG 99-3-22-1-3	-
T1	BG 99-3-22-1-4	-
T1	BG 99-9-28-1-4	-
T1	BG 00-6-7-1-1	-
T1	BG 00-6-7-1-2	-
T2	BG 98-12-9-1-2	-
T3	BG 98-9-24-3-1	-
T3	BG 98-9-24-3-2	-
T4	BG 98-9-2-2-4	-
T4	BG 00-6-23-2-1	-
T4	BG 00-6-23-2-2	-
T4	BG 00-6-26-1-2-1	-
T4	BG 00-6-26-1-2-2	-
T4	BG 00-6-26-1-2-3	-
T4	BG 00-7-5-1-2-2	-
T4	BG 00-7-5-1-3-1	-
T4	BG 00-7-5-1-3-2	-
T4	BG 00-7-5-1-4-1	-
T4	BG 00-7-5-1-4-2	-
T4	BG 00-6-23-1-1	-
T4	BG 00-6-23-1-2	-
T4	BG 00-6-23-1-3	-
T5	BG 99-8-18-1-1	-
T6	BG 99-8-18-1-3-1	-
T6	BG 99-8-18-1-3-2	-
T6	BG 99-8-18-1-6	-
T7	BG 99-8-18-1-4-1	-
T7	BG 99-8-18-1-4-2	-

Table 7 (continued). Results of the *Formation of Extracellular Amyloid Compounds Test.*

Grp	Isolate Number	Result
T9	BG 00-7-5-1-2-1	-
T9	BG 00-7-5-1-2-3	-
T10	BG 00-6-26-2-2-1	-
T11	BG 00-7-30-1-1	-
T11	BG 00-7-30-1-2	-
T11	BG 00-7-30-1-C	-
T11	BG 00-8-15-1-1	-
N1	BG 98-8-14-1-2-1	-
N1	BG 98-8-14-1-3-3	-
N1	BG 98-8-14-1-4-3	-
N2	BG 98-8-14-1-3-1	-
N3	BG 98-8-14-1-3-2	-
N3	BG 98-8-14-1-4-2	-
N4	BG 98-8-14-1-4-1	-
C1	BG 98-12-9-2-1	-
C1	BG 98-12-9-2-2-1	-
C1	BG 98-12-9-2-2-2	-
C2	BG 99-2-5-7-1-1	-
C2	BG 99-2-5-7-1-2	-
C2	BG 99-2-5-7-1-3	-
S1	BG 98-8-5-1-1	-
M1	BG 99-11-14-1-4-1	-
M2	BG 99-11-14-1-4-2	-
D1	BG 99-11-14-5-2-1	-
D1	BG 99-11-14-8-2-1	-
D1	BG 99-11-14-8-3-1	-
D2	BG 99-11-14-7-C	-

Symbols: +, positive; -, negative; N, no data

Table 8. Results of Yeast Isolate Growth at Various Temperatures.

Grp	Isolate Number	Temperature (C) 25	30	35	40
E1	BG 98-8-25-1-2	+	+	+	+
E1	BG 98-8-25-1-4	+	+	+	+
E1	BG 98-8-25-1-5	+	+	+	w
E1	BG 98-9-24-2-1	+	+	+	+
E2	BG 99-6-12-1-1	+	+	+	-
E3	BG 99-8-11-1-1	+	+	+	-
E3	BG 99-8-11-1-2-1	+	+	s	-
E3	BG 99-8-11-1-2-3	+	+	s	-
E3	BG 99-8-11-1-3	+	+	l	-
E4	BG 99-8-11-1-2-2	+	+	s	-
E4	BG 99-8-11-1-2-4	+	+	-	N
E4	BG 00-6-14-1-1	+	+	s	-
E4	BG 00-6-14-1-2	+	+	s	-
E4	BG 00-6-14-1-3	+	+	s	-
E4	BG 00-6-14-2-1	+	+	-	-
E4	BG 00-6-14-2-2	+	+	+	-
E4	BG 00-6-14-2-3	+	+	+	-
E5	BG 99-8-11-1-4-1	+	+	+	N
E6	BG 99-8-11-1-4-2	+	+	-	-
E7	BG 99-8-11-1-C1	+	+	s	N
E8	BG 99-8-11-1-C2	+	+	+	N
E9	BG 99-11-14-10-1-1	+	+	-	N
E9	BG 99-11-14-10-2-1	+	+	-	N
E9	BG 99-11-14-10-3-1	+	+	-	N
E9	BG 99-11-14-10-3-2	+	+	-	N
E9	BG 99-11-14-11-1-1	+	+	-	N
E9	BG 99-11-14-11-4-1	+	+	-	N
E9	BG 99-11-14-11-5-1	+	+	-	-
E10	BG 99-11-14-10-4-1	+	+	+	-
E12	BG 00-8-15-4-1	+	+	-	-

Grp	Number	Temperature (C) 25	30	35	40
T1	BG 98-8-18-2	+	+	+	-
T1	BG 98-12-9-1-1	+	+	+	N
T1	BG 98-12-9-1-3	+	+	+	N
T1	BG 99-2-5-2-1-1	+	+	-	N
T1	BG 99-2-5-2-1-2	+	+	-	N
T1	BG 99-3-22-1-1	+	+	-	N
T1	BG 99-3-22-1-2	+	+	-	-
T1	BG 99-3-22-1-3	+	+	+	-
T1	BG 99-3-22-1-4	+	+	+	-
T1	BG 99-9-28-1-4	+	+	+	N
T1	BG 00-6-7-1-1	+	+	-	-
T1	BG 00-6-7-1-2	+	+	+	N
T2	BG 98-12-9-1-2	+	l	l	+
T3	BG 98-9-24-3-1	+	+	-	N
T3	BG 98-9-24-3-2	+	+	-	N
T4	BG 98-9-2-2-4	+	+	s	-
T4	BG 00-6-23-2-1	+	+	+	-
T4	BG 00-6-23-2-2	+	+	-	N
T4	BG 00-6-26-1-2-1	+	+	-	N
T4	BG 00-6-26-1-2-2	+	+	s	-
T4	BG 00-6-26-1-2-3	+	+	-/w	N
T4	BG 00-7-5-1-2-2	+	+	-	N
T4	BG 00-7-5-1-3-1	+	+	-	N
T4	BG 00-7-5-1-3-2	+	+	-	N
T4	BG 00-7-5-1-4-1	+	+	-	N
T4	BG 00-7-5-1-4-2	+	+	-	N
T4	BG 00-6-23-1-1	+	+	-	N
T4	BG 00-6-23-1-2	+	+	s	-
T4	BG 00-6-23-1-3	+	+	-	N
T5	BG 99-8-18-1-1	+	+	w	-
T6	BG 99-8-18-1-3-1	+	+	+	-
T6	BG 99-8-18-1-3-2	+	+	+	w
T6	BG 99-8-18-1-6	+	+	-	N
T7	BG 99-8-18-1-4-1	+	+	+	-

Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; -, negative; N, no data

Table 8 (continued). Results of Yeast Isolate Growth at Various Temperatures.

Grp	Isolate Number	Temperature (C) 25	30	35	40
T7	BG 99-8-18-1-4-2	+	+	+	-
T9	BG 00-7-5-1-2-1	+	+	w	N
T9	BG 00-7-5-1-2-3	+	+	w	-
T10	BG 00-6-26-2-2-1	+	+	+	-
T11	BG 00-7-30-1-1	+	+	-	-
T11	BG 00-7-30-1-2	+	+	-	N
T11	BG 00-7-30-1-C	+	+	l	N
T11	BG 00-8-15-1-1	+	+	w	-
N1	BG 98-8-14-1-2-1	+	+	+	w
N1	BG 98-8-14-1-3-3	+	+	+	+
N1	BG 98-8-14-1-4-3	+	+	+	+
N2	BG 98-8-14-1-3-1	+	+	+	+
N3	BG 98-8-14-1-3-2	+	+	+	s
N3	BG 98-8-14-1-4-2	+	+	+	s
N4	BG 98-8-14-1-4-1	+	+	s	s
C1	BG 98-12-9-2-1	+	+	-	+
C1	BG 98-12-9-2-2-1	+	+	-	N
C1	BG 98-12-9-2-2-2	+	+	-	N
C2	BG 99-2-5-7-1-1	+	+	-	N
C2	BG 99-2-5-7-1-2	+	+	-	N
C2	BG 99-2-5-7-1-3	+	+	-	N
S1	BG 98-8-5-1-1	+	+	+	w
M2	BG 99-11-14-1-4-2	+	+	-	+
D1	BG 99-11-14-5-2-1	+	+	-	N
D1	BG 99-11-14-8-2-1	+	+	-	N
D1	BG 99-11-14-8-3-1	+	+	-	N
D2	BG 99-11-14-7-C	+	-	-	N

Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; -, negative; N, no data

Table 9. Results of the *Assimilation Tests of Nitrogen Compounds.*

Grp	Isolate Number	Nitrogen Compounds[a]									
		Nate	Nite	Eth	Lys	Cad	Cre	Cret	Glu	Imi	Try
E1	BG 98-8-25-1-2	-	-	+	+	+	-	-	-	-	-
E1	BG 98-8-25-1-4	-	-	+	+	+	-	-	-	-	-
E1	BG 98-8-25-1-5	-	-	+	+	+	-	-	-	-	-
E1	BG 98-9-24-2-1	-	-	+	+	+	-	-	-	-	-
E2	BG 99-6-12-1-1	-	-	+	+	+	-	-	-	-	-
E3	BG 99-8-11-1-1	-	-	+	+	+	-	-	+	-	-
E3	BG 99-8-11-1-2-1	-	-	+	+	+	-	-	+	-	-
E3	BG 99-8-11-1-2-3	-	-	+	+	+	-	-	+	-	-
E3	BG 99-8-11-1-3	-	-	+	+	+	-	-	+	-	-
E4	BG 99-8-11-1-2-2	-	-	+	+	+	-	-	-	-	-
E4	BG 99-8-11-1-2-4	-	-	+	+	+	-	-	-	-	-
E4	BG 00-6-14-1-1	-	-	+	+	+	-	-	-	-	-
E4	BG 00-6-14-1-2	-	-	+	+	+	-	-	-	-	-
E4	BG 00-6-14-1-3	-	-	+	+	+	-	-	-	-	-
E4	BG 00-6-14-2-1	-	-	+	+	+	-	-	-	-	-
E4	BG 00-6-14-2-2	-	-	+	+	+	-	-	l	-	-
E4	BG 00-6-14-2-3	-	-	+	+	+	-	-	l	-	-
E5	BG 99-8-11-1-4-1	-	-	+	+	+	+	+	+	-	-
E6	BG 99-8-11-1-4-2	-	-	+	+	+	-	-	-	-	-
E7	BG 99-8-11-1-C1	-	-	+	+	+	-	-	-	-	-
E8	BG 99-8-11-1-C2	-	-	+	+	+	-	-	-	-	-
E9	BG 99-11-14-10-1-1	-	-	+	+	+	-	-	-	-	-
E9	BG 99-11-14-10-2-1	-	-	+	+	+	-	-	-	-	-
E9	BG 99-11-14-10-3-1	-	-	+	+	+	-	-	-	-	-
E9	BG 99-11-14-10-3-2	-	-	+	+	+	-	-	+	-	w
E9	BG 99-11-14-11-1-1	-	-	+	+	+	-	-	-	-	-
E9	BG 99-11-14-11-4-1	-	-	+	+	+	-	-	-	-	-
E9	BG 99-11-14-11-5-1	-	-	+	+	+	-	-	-	-	-

[a] Abbreviations: Nate, nitrate (potassium); Nite, nitrite (sodium); Eth, ethylamine; Lys, L-lysine; Cad, cadaverine; Cre, creatine; Cret, creatinine; Glu, D-glucosamine; Imi, imidazole; Try, D-tryptophan
Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; -, negative; N, no data

Table 9 (continued). Results of the *Assimilation Tests of Nitrogen Compounds.*

Grp	Isolate Number	Nitrogen Compounds[a]									
		Nate	Nite	Eth	Lys	Cad	Cre	Cret	Glu	Imi	Try
E10	BG 99-11-14-10-4-1	-	-	+	+	+	-	-	-	-	-
E12	BG 00-8-15-4-1	-	-	+	+	+	-	-	+	-	-
T1	BG 98-8-18-2	-	-	+	+	+	-	-	-	-	-
T1	BG 98-12-9-1-1	-	-	+	+	+	-	-	-	-	-
T1	BG 98-12-9-1-3 -	-	+	+	+	-	-	-	-	-	
T1	BG 99-2-5-2-1-1	-	-	+	+	+	-	-	-	-	-
T1	BG 99-2-5-2-1-2	-	-	+	+	+	-	-	+	-	-
T1	BG 99-3-22-1-1	-	-	+	+	+	-	-	l	-	-
T1	BG 99-3-22-1-2	-	-	+	+	+	-	-	+	-	-
T1	BG 99-3-22-1-3	-	-	+	+	+	-	-	+	-	-
T1	BG 99-3-22-1-4	-	-	+	+	+	-	-	-	-	-
T1	BG 99-9-28-1-4	-	-	+	+	+	-	-	+	-	-
T1	BG 00-6-7-1-1	-	-	+	+	+	-	-	-	-	-
T1	BG 00-6-7-1-2	-	-	+	+	+	-	-	+	-	-
T2	BG 98-12-9-1-2	-	-	-	-	-	-	-	-	w	w
T3	BG 98-9-24-3-1	-	-	-	-	-	-	-	-	-	-
T3	BG 98-9-24-3-2	-	-	-	-	-	-	-	-	-	-
T4	BG 98-9-2-2-4	-	-	+	+	+	-	-	-	-	-
T4	BG 00-6-23-2-1	-	-	+	+	+	-	-	-	-	-
T4	BG 00-6-23-2-2	-	-	+	+	+	-	-	-	-	-
T4	BG 00-6-26-1-2-1	-	-	+	+	+	-	-	+	-	-
T4	BG 00-6-26-1-2-2	-	-	+	+	+	-	-	+	-	-
T4	BG 00-6-26-1-2-3	-	-	+	+	+	-	-	w	-	-
T4	BG 00-7-5-1-2-2	-	-	+	+	+	-	-	-	-	-
T4	BG 00-7-5-1-3-1	-	-	+	+	+	-	-	l	-	-
T4	BG 00-7-5-1-3-2	-	-	+	+	+	-	-	w	-	-
T4	BG 00-7-5-1-4-1	-	-	+	+	+	-	-	w	-	-
T4	BG 00-7-5-1-4-2	-	-	+	+	+	-	-	w	-	-
T4	BG 00-6-23-1-1	-	-	+	+	+	-	-	-	-	-
T4	BG 00-6-23-1-2	-	-	+	+	+	-	-	-	-	-
T4	BG 00-6-23-1-3	-	-	+	+	+	-	-	w	-	-

[a] Abbreviations: Nate, nitrate (potassium); Nite, nitrite (sodium); Eth, ethylamine; Lys, L-lysine; Cad, cadaverine; Cre, creatine; Cret, creatinine; Glu, D-glucosamine; Imi, imidazole; Try, D-tryptophan
Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; -, negative; N, no data

Table 9 (continued). Results of the *Assimilation Tests of Nitrogen Compounds*.

Grp	Isolate Number	Nitrogen Compounds[a]									
		Nate	Nite	Eth	Lys	Cad	Cre	Cret	Glu	Imi	Try
T5	BG 99-8-18-1-1	-	-	+	+	+	-	-	-	-	-
T6	BG 99-8-18-1-3-1	-	-	-	+	+	-	-	-	-	-
T6	BG 99-8-18-1-3-2	-	-	-	+	+	-	-	-	-	-
T6	BG 99-8-18-1-6	-	-	+	+	+	-	-	+	-	-
T7	BG 99-8-18-1-4-1	-	-	+	+	+	-	-	-	-	-
T7	BG 99-8-18-1-4-2	-	-	+	+	+	-	-	-	-	-
T9	BG 00-7-5-1-2-1	-	-	+	+	+	w	-	-	-	-
T9	BG 00-7-5-1-2-3	-	-	+	+	+	-	-	+	-	-
T10	BG 00-6-26-2-2-1	s	-	-	-	w	-	-	-	-	-
T11	BG 00-7-30-1-1	-	-	+	+	+	-	-	+	-	-
T11	BG 00-7-30-1-2	-	-	+	+	+	-	-	+	-	-
T11	BG 00-7-30-1-C	-	-	+	+	+	-	-	+	-	-
T11	BG 00-8-15-1-1	-	-	+	+	+	-	-	+	-	-
N1	BG 98-8-14-1-2-1	-	-	+	+	+	-	-	+	-	-
N1	BG 98-8-14-1-3-3	-	-	+	+	+	-	-	+	-	w
N1	BG 98-8-14-1-4-3	-	-	+	+	+	-	-	-	-	-
N2	BG 98-8-14-1-3-1	-	-	+	+	+	-	-	-	-	-
N3	BG 98-8-14-1-3-2	-	-	+	+	+	+	w	-	-	-
N3	BG 98-8-14-1-4-2	-	-	+	+	+	+	+	w	-	w
N4	BG 98-8-14-1-4-1	-	-	+	+	+	-	-	+	-	-
C1	BG 98-12-9-2-1	+	+	w	s	+	-	-	s	-	-
C1	BG 98-12-9-2-2-1	+	+	s	s	+	-	-	s	-	-
C1	BG 98-12-9-2-2-2	+	+	s	s	+	-	-	+	-	w
C2	BG 99-2-5-7-1-1	-	-	+	+	+	-	-	-	-	-
C2	BG 99-2-5-7-1-2	-	-	+	+	+	-	-	-	-	-
C2	BG 99-2-5-7-1-3	-	-	+	+	+	-	-	+	-	-

[a] Abbreviations: Nate, nitrate (potassium); Nite, nitrite (sodium); Eth, ethylamine; Lys, L-lysine; Cad, cadaverine; Cre, creatine; Cret, creatinine; Glu, D-glucosamine; Imi, imidazole; Try, D-tryptophan
Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; -, negative; N, no data

Table 9 (continued). Results of the *Assimilation Tests of Nitrogen Compounds.*

Grp	Isolate Number	Nitrogen Compounds[a]									
		Nate	Nite	Eth	Lys	Cad	Cre	Cret	Glu	Imi	Try
S1	BG 98-8-5-1-1	-	-	+	+	+	-	-	-	-	-
M2	BG 99-11-14-1-4-2	-	-	+	+	+	-	-	-	-	-
D1	BG 99-11-14-5-2-1	-	-	+	+	+	-	-	-	-	-
D1	BG 99-11-14-8-2-1	-	-	+	+	+	-	-	+	-	-
D1	BG 99-11-14-8-3-1	-	-	+	+	+	-	-	+	-	-
D2	BG 99-11-14-7-C	-	-	+	+	+	-	-	+	-	-

[a] Abbreviations: Nate, nitrate (potassium); Nite, nitrite (sodium); Eth, ethylamine; Lys, L-lysine; Cad, cadaverine; Cre, creatine; Cret, creatinine; Glu, D-glucosamine; Imi, imidazole; Try, D-tryptophan
Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; -, negative; N, no data

Table 10. Results of the *Tests for Vitamin Requirements.*

Grp	Isolate Number	Vitamins[a]									
		None	No Ino	No Pan	No Bio	No Thi	No Bio & Thi	No Pyr	No Pyr & Thi	No Nia	No PABA
E1	BG 98-8-25-1-2	–	+	+	–	+	–	+	+	+	+
E1	BG 98-8-25-1-4	–	+	+	–	+	–	+	+	+	+
E1	BG 98-8-25-1-5	–	+	+	–	+	–	+	+	+	+
E1	BG 98-9-24-2-1	–	+	+	–	+	–	+	+	+	+
E2	BG 99-6-12-1-1	–	+	+	–	+	–	+	+	+	+
E3	BG 99-8-11-1-1	–	+	+	–	+	–	+	+	+	+
E3	BG 99-8-11-1-2-1	–	+	+	–	+	–	+	+	+	+
E3	BG 99-8-11-1-2-3	–	+	+	–	+	–	+	+	+	+
E3	BG 99-8-11-1-3	–	+	+	–	+	–	+	+	+	+
E4	BG 99-8-11-1-2-2	–	+	+	–	+	–	+	+	+	+
E4	BG 99-8-11-1-2-4	–	+	+	–	+	–	+	+	+	+
E4	BG 00-6-14-1-1	–	+	+	–	+	–	+	+	+	+
E4	BG 00-6-14-1-2	–	+	+	–	+	–	+	+	+	+
E4	BG 00-6-14-1-3	–	+	+	–	+	–	+	+	+	+
E4	BG 00-6-14-2-1	–	+	+	–	+	–	+	+	+	+
E4	BG 00-6-14-2-2	–	+	+	–	+	–	+	+	+	+
E4	BG 00-6-14-2-3	–	+	+	–	+	–	+	+	+	+
E5	BG 99-8-11-1-4-1	–	+	+	–	+	w	+	+	+	+
E6	BG 99-8-11-1-4-2	–	+	+	–	+	–	+	+	+	+
E7	BG 99-8-11-1-C1	–	+	+	–	+	–	+	+	+	+
E8	BG 99-8-11-1-C2	–	+	+	–	+	–	+	+	+	+
E9	BG 99-11-14-10-1-1	–	+	+	w	+	w	+	+	+	+
E9	BG 99-11-14-10-2-1	–	+	+	+	+	–	+	+	+	+
E9	BG 99-11-14-10-3-1	–	+	+	w	+	–	+	+	+	+
E9	BG 99-11-14-10-3-2	–	+	+	w	+	w	+	+	+	+
E9	BG 99-11-14-11-1-1	–	+	+	w	+	–	+	+	+	+
E9	BG 99-11-14-11-4-1	–	+	+	w	+	–	+	+	+	+
E9	BG 99-11-14-11-5-1	–	+	+	w	+	w	+	+	+	+

[a] Abbreviations: Ino, myo-inositol; Pan, pantothenate; Bio, biotin; Thi, thiamin; Pyr, pyridoxine; Nia, niacin
Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; –, negative; N, no data

Table 10 (continued). Results of the *Tests for Vitamin Requirements.*

Grp	Isolate Number	Vitamins[a]									
		None	No Ino	No Pan	No Bio	No Thi	No Bio & Thi	No Pyr	No Pyr & Thi	No Nia	No PABA
E10	BG 99-11-14-10-4-1	–	+	+	w	–	–	w	–	+	+
E12	BG 00-8-15-4-1	–	+	+	w	+	w	+	+	+	+
T1	BG 98-8-18-2	–	+	+	–	+	–	+	+	+	+
T1	BG 98-12-9-1-1	–	+	+	–	+	–	+	+	+	+
T1	BG 98-12-9-1-3	–	+	+	–	+	–	+	+	+	+
T1	BG 99-2-5-2-1-1	–	+	+	–	+	–	+	+	+	+
T1	BG 99-2-5-2-1-2	–	+	+	w	+	w	+	+	+	+
T1	BG 99-3-22-1-1	–	+	+	w	+	w	+	+	+	+
T1	BG 99-3-22-1-2	–	+	+	w	+	w	+	+	+	+
T1	BG 99-3-22-1-3	–	+	+	w	+	–	+	+	+	+
T1	BG 99-3-22-1-4	–	+	+	–	+	–	+	+	+	+
T1	BG 99-9-28-1-4	–	+	+	w	+	–	+	+	+	+
T1	BG 00-6-7-1-1	–	+	+	–	+	–	+	+	+	+
T1	BG 00-6-7-1-2	–	+	+	–	+	–	+	+	+	+
T2	BG 98-12-9-1-2	–	+	+	+	–	–	+	–	+	+
T3	BG 98-9-24-3-1	–	+	+	+	–	–	+	–	+	+
T3	BG 98-9-24-3-2	–	+	+	+	–	–	+	–	+	+
T4	BG 98-9-2-2-4	–	+	+	–	+	–	+	+	+	+
T4	BG 00-6-23-2-1	–	+	+	–	+	–	+	+	+	+
T4	BG 00-6-23-2-2	–	+	+	–	+	–	+	+	+	+
T4	BG 00-6-26-1-2-1	–	+	+	–	+	–	+	+	+	+
T4	BG 00-6-26-1-2-2	–	+	+	–	+	–	+	+	+	+
T4	BG 00-6-26-1-2-3	–	+	+	–	+	–	+	+	+	+
T4	BG 00-7-5-1-2-2	–	+	+	–	+	–	+	+	+	+
T4	BG 00-7-5-1-3-1	–	+	+	–	+	–	+	+	+	+
T4	BG 00-7-5-1-3-2	–	+	+	–	+	–	+	+	+	+
T4	BG 00-7-5-1-4-1	–	+	+	–	+	–	+	+	+	+
T4	BG 00-7-5-1-4-2	–	+	+	–	+	–	+	+	+	+

[a] Abbreviations: Ino, myo-inositol; Pan, pantothenate; Bio, biotin; Thi, thiamin; Pyr, pyridoxine; Nia, niacin
Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; -, negative; N, no data

Table 10 (continued). Results of the *Tests for Vitamin Requirements.*

Grp	Isolate Number	Vitamins[a]									
		None	No Ino	No Pan	No Bio	No Thi	No Bio & Thi	No Pyr	No Pyr & Thi	No Nia	No PABA
T4	BG 00-6-23-1-1	-	+	+	-	+	-	+	+	+	+
T4	BG 00-6-23-1-2	-	+	+	-	+	-	+	+	+	+
T4	BG 00-6-23-1-3	-	+	+	-	+	-	+	+	+	+
T5	BG 99-8-18-1-1	-	+	+	-	+	-	+	+	+	+
T6	BG 99-8-18-1-3-1	-	+	+	-	-	-	w	-	+	+
T6	BG 99-8-18-1-3-2	-	+	+	-	-	-	w	-	+	+
T6	BG 99-8-18-1-6 -	+	+	-	-	-	w	-	+	+	
T7	BG 99-8-18-1-4-1	-	+	+	-	+	-	+	+	+	+
T7	BG 99-8-18-1-4-2	-	+	+	-	+	-	+	+	+	+
T9	BG 00-7-5-1-2-3	-	+	+	+	-	-	+	-	+	+
T10	BG 00-6-26-2-2-1	-	+	+	-	-	-	+	-	+	+
T11	BG 00-7-30-1-1	-	+	+	-	+	w	+	+	+	+
T11	BG 00-7-30-1-2	-	+	+	w	+	w	+	+	+	+
T11	BG 00-7-30-1-C	-	+	+	w	+	w	+	+	+	+
T11	BG 00-8-15-1-1	-	+	+	w	+	w	+	+	+	+
N1	BG 98-8-14-1-2-1	-	+	+	w	+	w	+	+	+	+
N1	BG 98-8-14-1-3-3	-	+	+	w	+	w	+	+	+	+
N1	BG 98-8-14-1-4-3	-	+	+	w	+	w	+	+	+	+
N2	BG 98-8-14-1-3-1	-	+	+	w	+	w	+	+	+	+
N3	BG 98-8-14-1-3-2	+	+	+	+	+	+	+	+	+	+
N3	BG 98-8-14-1-4-2	+	+	+	+	+	+	+	+	+	+
N4	BG 98-8-14-1-4-1	-	+	+	w	-	-	+	-	+	+
C1	BG 98-12-9-2-1	-	+	+	+	-	-	+	-	+	+
C1	BG 98-12-9-2-2-1	-	+	+	+	-	-	+	-	+	+
C1	BG 98-12-9-2-2-2	-	+	+	+	-	-	+	-	+	+

[a] Abbreviations: Ino, myo-inositol; Pan, pantothenate; Bio, biotin; Thi, thiamin; Pyr, pyridoxine; Nia, niacin
Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; -, negative; N, no data

Table 10 (continued). Results of the *Tests for Vitamin Requirements.*

Grp	Isolate Number	Vitamins[a]									
		None	No Ino	No Pan	No Bio	No Thi	No Bio & Thi	No Pyr	No Pyr & Thi	No Nia	No PABA
C2	BG 99-2-5-7-1-1	-	+	+	w	-	w	+	+	+	+
C2	BG 99-2-5-7-1-2	-	+	+	w	+	w	+	+	+	+
C2	BG 99-2-5-7-1-3	-	+	+	w	+	w	+	+	+	+
S1	BG 98-8-5-1-1	-	+	+	w	+	w	+	+	+	+
M2	BG 99-11-14-1-4-2	-	+	+	-	+	-	+	+	+	+
D1	BG 99-11-14-5-2-1	-	+	+	-	+	-	+	+	+	+
D1	BG 99-11-14-8-2-1	-	+	+	-	+	-	+	+	+	+
D1	BG 99-11-14-8-3-1	-	+	+	-	+	-	+	+	+	+
D2	BG 99-11-14-7-C	-	+	+	-	+	w	+	+	+	+

[a] Abbreviations: Ino, myo-inositol; Pan, pantothenate; Bio, biotin; Thi, thiamin; Pyr, pyridoxine; Nia, niacin
Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; -, negative; N, no data

Table 11. Results of Yeast Isolate *Growth in Media of High Osmotic Pressures.*

Grp	Isolate Number	50% D-glucose	60% D-glucose	10% NaCl	16% NaCl	5% NaCl
E1	BG 98-8-25-1-2	w	–	+	–	+
E1	BG 98-8-25-1-4	l	–	+	–	+
E1	BG 98-8-25-1-5	s	–	+	–	+
E1	BG 98-9-24-2-1	w	–	+	–	+
E2	BG 99-6-12-1-1	w	–	l	–	+
E3	BG 99-8-11-1-1	–	w	l	–	+
E3	BG 99-8-11-1-2-1	l	w	+	–	+
E3	BG 99-8-11-1-2-3	l	w	+	–	+
E3	BG 99-8-11-1-3	l	w	l	–	+
E4	BG 99-8-11-1-2-2	l	w	l	–	+
E4	BG 99-8-11-1-2-4	+	w	+	–	+
E4	BG 00-6-14-1-1	l	w	+	w	+
E4	BG 00-6-14-1-2	+	w	+	–	+
E4	BG 00-6-14-1-3	+	w	+	–	+
E4	BG 00-6-14-2-1	+	–	+	–	+
E4	BG 00-6-14-2-2	l	w	+	–	+
E4	BG 00-6-14-2-3	+	w	+	–	+
E5	BG 99-8-11-1-4-1	+	+	+	+	+
E6	BG 99-8-11-1-4-2	l	w	l	–	+
E7	BG 99-8-11-1-C1	l	–	+	w	+
E8	BG 99-8-11-1-C2	+	l	+	w	+
E9	BG 99-11-14-10-1-1	l	–	+	–	+
E9	BG 99-11-14-10-2-1	+	–	+	–	+
E9	BG 99-11-14-10-3-1	+	–	+	–	+
E9	BG 99-11-14-10-3-2	l	–	+	–	+
E9	BG 99-11-14-11-1-1	l	–	+	–	+
E9	BG 99-11-14-11-4-1	l	–	+	–	+
E9	BG 99-11-14-11-5-1	l	–	+	–	+
E10	BG 99-11-14-10-4-1	–	–	–	–	+
E12	BG 00-8-15-4-1	–	–	–	–	+

Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; –, negative; N, no data

Table 11 (continued). Results of Yeast Isolate *Growth in Media of High Osmotic Pressures.*

Grp	Isolate Number	50% D-glucose	60% D-glucose	10% NaCl	16% NaCl	5% NaCl
T1	BG 98-8-18-2	l	w	+	-	+
T1	BG 98-12-9-1-1	l	s	+	-	+
T1	BG 98-12-9-1-3	l	w	+	-	+
T1	BG 99-2-5-2-1-1	+	s	+	-	+
T1	BG 99-2-5-2-1-2	+	w	+	-	+
T1	BG 99-3-22-1-1	+	w	+	-	+
T1	BG 99-3-22-1-2	l	w	+	-	+
T1	BG 99-3-22-1-3	+	l	+	w	+
T1	BG 99-3-22-1-4	+	w	+	-	+
T1	BG 99-9-28-1-4	+	l	+	l	+
T1	BG 00-6-7-1-1	+	w	+	w	+
T1	BG 00-6-7-1-2	+	l	+	w	+
T2	BG 98-12-9-1-2	-	-	-	-	-
T3	BG 98-9-24-3-1	-	-	-	-	-
T3	BG 98-9-24-3-2	-	-	-	-	-
T4	BG 98-9-2-2-4	l	+	+	-	+
T4	BG 00-6-23-2-1	+	w	+	-	+
T4	BG 00-6-23-2-2	+	w	+	-	+
T4	BG 00-6-26-1-2-1	l	w	+	w	+
T4	BG 00-6-26-1-2-2	+	-	+	-	+
T4	BG 00-6-26-1-2-3	+	-	+	-	+
T4	BG 00-7-5-1-2-2	+	-	+	-/w	+
T4	BG 00-7-5-1-3-1	l	w	+	-	+
T4	BG 00-7-5-1-3-2	+	-	+	-	+
T4	BG 00-7-5-1-4-1	+	-	+	-	+
T4	BG 00-7-5-1-4-2	+	-	+	-	+
T4	BG 00-6-23-1-1	+	w	+	-	+
T4	BG 00-6-23-1-2	+	w	+	-	+
T4	BG 00-6-23-1-3	+	w	+	-	+
T5	BG 99-8-18-1-1	+	s	+	-	+
T6	BG 99-8-18-1-3-1	s	-	+	-	+
T6	BG 99-8-18-1-3-2	s	-	+	-	+
T6	BG 99-8-18-1-6	-	-	+	-	+
T7	BG 99-8-18-1-4-1	+	w	+	-	+
T7	BG 99-8-18-1-4-2	+	w	+	w	+

Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; -, negative; N, no data

Table 11 (continued). Results of Yeast Isolate *Growth in Media of High Osmotic Pressures.*

Grp	Isolate Number	50% D-glucose	60% D-glucose	10% NaCl	16% NaCl	5% NaCl
T9	BG 00-7-5-1-2-1	w	w	+	s	+
T9	BG 00-7-5-1-2-3	w	-	+	s	+
T10	BG 00-6-26-2-2-1	-	-	-	-	+
T11	BG 00-7-30-1-1	+	w	s	-	+
T11	BG 00-7-30-1-2	l	w	s	-	+
T11	BG 00-7-30-1-C	l	w	s	-	+
T11	BG 00-8-15-1-1	+	-	l	-	+
N1	BG 98-8-14-1-2-1	+	s	+	w	+
N1	BG 98-8-14-1-3-3	+	l	+	w	+
N1	BG 98-8-14-1-4-3	l	w	+	w	+
N2	BG 98-8-14-1-3-1	+	+	+	+	+
N3	BG 98-8-14-1-3-2	+	l	+	w	+
N3	BG 98-8-14-1-4-2	+	+	+	l	+
N4	BG 98-8-14-1-4-1	+	w	-	-	+
C1	BG 98-12-9-2-1	w	-	l	-	+
C1	BG 98-12-9-2-2-1	w	-	l	-	+
C1	BG 98-12-9-2-2-2	w	-	l	-	+
C2	BG 99-2-5-7-1-1	l	s	+	-	+
C2	BG 99-2-5-7-1-2	l	s	+	-	+
C2	BG 99-2-5-7-1-3	l	w	+	-	+
S1	BG 98-8-5-1-1	+	s	+	w	+
M1	BG 99-11-14-1-4-1	+	w	+	s	+
M2	BG 99-11-14-1-4-2	s	-	l	-	+
D1	BG 99-11-14-5-2-1	-	-	-	-	w
D1	BG 99-11-14-8-2-1	-	-	-	-	s
D1	BG 99-11-14-8-3-1	-	-	-	-	s
D2	BG 99-11-14-7-C	-	-	-	-	s

Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; -, negative; N, no data

Table 12. Results of Yeast Isolate Growth in %1 Acetic Acid.

Grp	Isolate Number	Growth
E1	BG 98-8-25-1-2	-
E1	BG 98-8-25-1-4	-
E1	BG 98-8-25-1-5	-
E1	BG 98-9-24-2-1	-
E2	BG 99-6-12-1-1	-
E3	BG 99-8-11-1-1	-
E3	BG 99-8-11-1-2-1	-
E3	BG 99-8-11-1-2-3	-
E3	BG 99-8-11-1-3	-
E4	BG 99-8-11-1-2-2	-
E4	BG 99-8-11-1-2-4	-
E4	BG 00-6-14-1-1	-
E4	BG 00-6-14-1-2	-
E4	BG 00-6-14-1-3	-
E4	BG 00-6-14-2-1	-
E4	BG 00-6-14-2-2	-
E4	BG 00-6-14-2-3	-
E5	BG 99-8-11-1-4-1	-
E6	BG 99-8-11-1-4-2	-
E7	BG 99-8-11-1-C1	-
E8	BG 99-8-11-1-C2	-
E9	BG 99-11-14-10-1-1	-
E9	BG 99-11-14-10-2-1	-
E9	BG 99-11-14-10-3-1	-
E9	BG 99-11-14-10-3-2	-
E9	BG 99-11-14-11-1-1	-
E9	BG 99-11-14-11-4-1	-
E9	BG 99-11-14-11-5-1	-
E10	BG 99-11-14-10-4-1	-
E12	BG 00-8-15-4-1	-

Grp	Isolate Number	Growth
T1	BG 98-8-18-2	-
T1	BG 98-12-9-1-1	-
T1	BG 98-12-9-1-3	-
T1	BG 99-2-5-2-1-1	-
T1	BG 99-2-5-2-1-2	-
T1	BG 99-3-22-1-1	-
T1	BG 99-3-22-1-2	-
T1	BG 99-3-22-1-3	-
T1	BG 99-3-22-1-4	-
T1	BG 99-9-28-1-4	-
T1	BG 00-6-7-1-1	-
T1	BG 00-6-7-1-2	-
T2	BG 98-12-9-1-2	-
T3	BG 98-9-24-3-1	-
T3	BG 98-9-24-3-2	-
T4	BG 98-9-2-2-4	-
T4	BG 00-6-23-2-1	-
T4	BG 00-6-23-2-2	-
T4	BG 00-6-26-1-2-1	-
T4	BG 00-6-26-1-2-2	-
T4	BG 00-6-26-1-2-3	-
T4	BG 00-7-5-1-2-2	-
T4	BG 00-7-5-1-3-1	-
T4	BG 00-7-5-1-3-2	-
T4	BG 00-7-5-1-4-1	-
T4	BG 00-7-5-1-4-2	-
T4	BG 00-6-23-1-1	-
T4	BG 00-6-23-1-2	-
T4	BG 00-6-23-1-3	-
T5	BG 99-8-18-1-1	-
T6	BG 99-8-18-1-3-1	-
T6	BG 99-8-18-1-3-2	-
T6	BG 99-8-18-1-6	-
T7	BG 99-8-18-1-4-1	-
T7	BG 99-8-18-1-4-2	-

Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; -, negative; N, no data

Table 12 (continued). Results of Yeast Isolate Growth in %1 Acetic Acid.

Grp	Isolate Number	Growth
T9	BG 00-7-5-1-2-1	-
T9	BG 00-7-5-1-2-3	-
T10	BG 00-6-26-2-2-1	-
T11	BG 00-7-30-1-1	-
T11	BG 00-7-30-1-2	-
T11	BG 00-7-30-1-C	-
T11	BG 00-8-15-1-1	-
N1	BG 98-8-14-1-2-1	-
N1	BG 98-8-14-1-3-3	-
N1	BG 98-8-14-1-4-3	-
N2	BG 98-8-14-1-3-1	-
N3	BG 98-8-14-1-3-2	-
N3	BG 98-8-14-1-4-2	-
N4	BG 98-8-14-1-4-1	-
C1	BG 98-12-9-2-1	-
C1	BG 98-12-9-2-2-1	-
C1	BG 98-12-9-2-2-2	-
C2	BG 99-2-5-7-1-1	-
C2	BG 99-2-5-7-1-2	-
C2	BG 99-2-5-7-1-3	-
S1	BG 98-8-5-1-1	-
M1	BG 99-11-14-1-4-1	-
M2	BG 99-11-14-1-4-2	-
D1	BG 99-11-14-5-2-1	-
D1	BG 99-11-14-8-2-1	-
D1	BG 99-11-14-8-3-1	-
D2	BG 99-11-14-7-C	-

Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; -, negative; N, no data

Table 13. Results of the *Hydrolysis of Urea Test.*

Grp	Isolate Number	Growth
E1	BG 98-8-25-1-2	-
E1	BG 98-8-25-1-4	-
E1	BG 98-8-25-1-5	-
E1	BG 98-9-24-2-1	-
E2	BG 99-6-12-1-1	-
E3	BG 99-8-11-1-1	-
E3	BG 99-8-11-1-2-1	-
E3	BG 99-8-11-1-2-3	-
E3	BG 99-8-11-1-3	-
E4	BG 99-8-11-1-2-2	-
E4	BG 99-8-11-1-2-4	-
E4	BG 00-6-14-1-1	-
E4	BG 00-6-14-1-2	-
E4	BG 00-6-14-1-3	-
E4	BG 00-6-14-2-1	-
E4	BG 00-6-14-2-2	-
E4	BG 00-6-14-2-3	-
E5	BG 99-8-11-1-4-1	-
E6	BG 99-8-11-1-4-2	-
E7	BG 99-8-11-1-C1	-
E8	BG 99-8-11-1-C2	-
E9	BG 99-11-14-10-1-1	-
E9	BG 99-11-14-10-2-1	-
E9	BG 99-11-14-10-3-1	-
E9	BG 99-11-14-10-3-2	-
E9	BG 99-11-14-11-1-1	-
E9	BG 99-11-14-11-4-1	-
E9	BG 99-11-14-11-5-1	-
E10	BG 99-11-14-10-4-1	-
E12	BG 00-8-15-4-1	-

Grp	Isolate Number	Growth
T1	BG 98-8-18-2	-
T1	BG 98-12-9-1-1	-
T1	BG 98-12-9-1-3	-
T1	BG 99-2-5-2-1-1	-
T1	BG 99-2-5-2-1-2	-
T1	BG 99-3-22-1-1	-
T1	BG 99-3-22-1-2	-
T1	BG 99-3-22-1-3	-
T1	BG 99-3-22-1-4	-
T1	BG 99-9-28-1-4	-
T1	BG 00-6-7-1-1	-
T1	BG 00-6-7-1-2	-
T2	BG 98-12-9-1-2	+
T3	BG 98-9-24-3-1	w
T3	BG 98-9-24-3-2	+
T4	BG 98-9-2-2-4	-
T4	BG 00-6-23-2-1	-
T4	BG 00-6-23-2-2	-
T4	BG 00-6-26-1-2-1	-
T4	BG 00-6-26-1-2-2	-
T4	BG 00-6-26-1-2-3	-
T4	BG 00-7-5-1-2-2	-
T4	BG 00-7-5-1-3-1	-
T4	BG 00-7-5-1-3-2	-
T4	BG 00-7-5-1-4-1	-
T4	BG 00-7-5-1-4-2	-
T4	BG 00-6-23-1-1	-
T4	BG 00-6-23-1-2	-
T4	BG 00-6-23-1-3	-
T5	BG 99-8-18-1-1	-
T6	BG 99-8-18-1-3-1	-
T6	BG 99-8-18-1-3-2	-
T6	BG 99-8-18-1-6	-
T7	BG 99-8-18-1-4-1	-
T7	BG 99-8-18-1-4-2	-

Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; -, negative; N, no data

Table 13 (continued). Results of the *Hydrolysis of Urea Test.*

Grp	Isolate Number	Growth
T9	BG 00-7-5-1-2-1	-
T9	BG 00-7-5-1-2-3	-
T10	BG 00-6-26-2-2-1	-
T11	BG 00-7-30-1-1	-
T11	BG 00-7-30-1-2	-
T11	BG 00-7-30-1-C	-
T11	BG 00-8-15-1-1	-
N1	BG 98-8-14-1-2-1	-
N1	BG 98-8-14-1-3-3	-
N1	BG 98-8-14-1-4-3	-
N2	BG 98-8-14-1-3-1	-
N3	BG 98-8-14-1-3-2	-
N3	BG 98-8-14-1-4-2	-
N4	BG 98-8-14-1-4-1	-
C1	BG 98-12-9-2-1	-
C1	BG 98-12-9-2-2-1	-
C1	BG 98-12-9-2-2-2	-
C2	BG 99-2-5-7-1-1	-
C2	BG 99-2-5-7-1-2	-
C2	BG 99-2-5-7-1-3	-
S1	BG 98-8-5-1-1	-
M1	BG 99-11-14-1-4-1	-
M2	BG 99-11-14-1-4-2	-
D1	BG 99-11-14-5-2-1	-
D1	BG 99-11-14-8-2-1	-
D1	BG 99-11-14-8-3-1	-
D2	BG 99-11-14-7-C	-

Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; -, negative; N, no data

Table 14. Results of Yeast Isolate Growth in 0.01% and 0.1% Cycloheximide.

Grp	Isolate Number	0.01%	0.1%
E1	BG 98-8-25-1-2	l	–
E1	BG 98-8-25-1-4	w	–
E1	BG 98-8-25-1-5	w	–
E1	BG 98-9-24-2-1	w	–
E2	BG 99-6-12-1-1	–	–
E3	BG 99-8-11-1-1	–	–
E3	BG 99-8-11-1-2-1	–	–
E3	BG 99-8-11-1-2-3	–	–
E3	BG 99-8-11-1-3	l	–
E4	BG 99-8-11-1-2-2	l	–
E4	BG 99-8-11-1-2-4	w	–
E4	BG 00-6-14-1-1	l	–
E4	BG 00-6-14-1-2	w	–
E4	BG 00-6-14-1-3	w	–
E4	BG 00-6-14-2-1	s	–
E4	BG 00-6-14-2-2	l	–
E4	BG 00-6-14-2-3	l	–
E5	BG 99-8-11-1-4-1	w	–
E6	BG 99-8-11-1-4-2	w	–
E7	BG 99-8-11-1-C1	+	+
E8	BG 99-8-11-1-C2	+	–
E9	BG 99-11-14-10-1-1	–	–
E9	BG 99-11-14-10-2-1	–	–
E9	BG 99-11-14-10-3-1	–	–
E9	BG 99-11-14-10-3-2	–	–
E9	BG 99-11-14-11-1-1	–	–
E9	BG 99-11-14-11-4-1	–	–
E9	BG 99-11-14-11-5-1	–	–
E10	BG 99-11-14-10-4-1	–	–
E12	BG 00-8-15-4-1	–	–

Grp	Isolate Number	0.01%	0.1%
T1	BG 98-8-18-2	+	+
T1	BG 98-12-9-1-1	+	+
T1	BG 98-12-9-1-3	+	+
T1	BG 99-2-5-2-1-1	+	+
T1	BG 99-2-5-2-1-2	+	+
T1	BG 99-3-22-1-1	+	+
T1	BG 99-3-22-1-2	+	+
T1	BG 99-3-22-1-3	+	+
T1	BG 99-3-22-1-4	+	+
T1	BG 99-9-28-1-4	+	+
T1	BG 00-6-7-1-1	+	+
T1	BG 00-6-7-1-2	+	+
T2	BG 98-12-9-1-2	l	s
T3	BG 98-9-24-3-1	+	–
T3	BG 98-9-24-3-2	+	–
T4	BG 98-9-2-2-4	l	–
T4	BG 00-6-23-2-1	–	–
T4	BG 00-6-23-2-2	–	–
T4	BG 00-6-26-1-2-1	l	–
T4	BG 00-6-26-1-2-2	w	–
T4	BG 00-6-26-1-2-3	w	–
T4	BG 00-7-5-1-2-2	l	–
T4	BG 00-7-5-1-3-1	s	–
T4	BG 00-7-5-1-3-2	l	–
T4	BG 00-7-5-1-4-1	+	–
T4	BG 00-7-5-1-4-2	l	–
T4	BG 00-6-23-1-1	w	–
T4	BG 00-6-23-1-2	s	–
T4	BG 00-6-23-1-3	w	–
T5	BG 99-8-18-1-1	w	–
T6	BG 99-8-18-1-3-1	–	–
T6	BG 99-8-18-1-3-2	–	–
T6	BG 99-8-18-1-6	–	+
T7	BG 99-8-18-1-4-1	+	–
T7	BG 99-8-18-1-4-2	+	–

Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; –, negative; N, no data

Table 14 (continued). Results of Yeast Isolate Growth in 0.01% and 0.1% Cycloheximide.

Grp	Isolate Number	0.01%	0.1%
T9	BG 00-7-5-1-2-1	+	+
T9	BG 00-7-5-1-2-3	+	+
T10	BG 00-6-26-2-2-1	+	+
T11	BG 00-7-30-1-1	-	-
T11	BG 00-7-30-1-2	-	-
T11	BG 00-7-30-1-C	w	-
T11	BG 00-8-15-1-1	-	-
N1	BG 98-8-14-1-2-1	+	+
N1	BG 98-8-14-1-3-3	+	+
N1	BG 98-8-14-1-4-3	+	+
N2	BG 98-8-14-1-3-1	s	-
N3	BG 98-8-14-1-3-2	+	+
N3	BG 98-8-14-1-4-2	+	+
N4	BG 98-8-14-1-4-1	+	+
C1	BG 98-12-9-2-1	+	+
C1	BG 98-12-9-2-2-1	+	+
C1	BG 98-12-9-2-2-2	+	+
C2	BG 99-2-5-7-1-1	+	+
C2	BG 99-2-5-7-1-2	+	+
C2	BG 99-2-5-7-1-3	+	+
S1	BG 98-8-5-1-1	+	+
M1	BG 99-11-14-1-4-1	+	+
M2	BG 99-11-14-1-4-2	+	+
D1	BG 99-11-14-5-2-1	-	-
D1	BG 99-11-14-8-2-1	-	-
D1	BG 99-11-14-8-3-1	-	-
D2	BG 99-11-14-7-C	s	-

Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; -, negative; N, no data

Table 15. Results of the *Gelatin Liquefaction Test*.

Grp	Isolate Number	Result
E1	BG 98-8-25-1-2	-
E1	BG 98-8-25-1-4	-
E1	BG 98-8-25-1-5	-
E1	BG 98-9-24-2-1	-
E2	BG 99-6-12-1-1	-
E3	BG 99-8-11-1-1	-
E3	BG 99-8-11-1-2-1	-
E3	BG 99-8-11-1-2-3	-
E3	BG 99-8-11-1-3	-
E4	BG 99-8-11-1-2-2	-
E4	BG 99-8-11-1-2-4	-
E4	BG 00-6-14-1-1	-
E4	BG 00-6-14-1-2	-
E4	BG 00-6-14-1-3	-
E4	BG 00-6-14-2-1	-
E4	BG 00-6-14-2-2	-
E4	BG 00-6-14-2-3	-
E5	BG 99-8-11-1-4-1	-
E6	BG 99-8-11-1-4-2	-
E7	BG 99-8-11-1-C1	-
E8	BG 99-8-11-1-C2	-
E9	BG 99-11-14-10-1-1	-
E9	BG 99-11-14-10-2-1	-
E9	BG 99-11-14-10-3-1	-
E9	BG 99-11-14-10-3-2	-
E9	BG 99-11-14-11-1-1	-
E9	BG 99-11-14-11-4-1	-
E9	BG 99-11-14-11-5-1	-
E10	BG 99-11-14-10-4-1	-
E12	BG 00-8-15-4-1	-

Grp	Isolate Number	Result
T1	BG 98-8-18-2	-
T1	BG 98-12-9-1-1	-
T1	BG 98-12-9-1-3	-
T1	BG 99-2-5-2-1-1	-
T1	BG 99-2-5-2-1-2	-
T1	BG 99-3-22-1-1	-
T1	BG 99-3-22-1-2	-
T1	BG 99-3-22-1-3	-
T1	BG 99-3-22-1-4	-
T1	BG 99-9-28-1-4	-
T1	BG 00-6-7-1-1	-
T1	BG 00-6-7-1-2	-
T2	BG 98-12-9-1-2	-
T3	BG 98-9-24-3-1	-
T3	BG 98-9-24-3-2	-
T4	BG 98-9-2-2-4	-
T4	BG 00-6-23-2-1	-
T4	BG 00-6-23-2-2	-
T4	BG 00-6-26-1-2-1	-
T4	BG 00-6-26-1-2-2	-
T4	BG 00-6-26-1-2-3	-
T4	BG 00-7-5-1-2-2	-
T4	BG 00-7-5-1-3-1	-
T4	BG 00-7-5-1-3-2	-
T4	BG 00-7-5-1-4-1	-
T4	BG 00-7-5-1-4-2	-
T4	BG 00-6-23-1-1	-
T4	BG 00-6-23-1-2	-
T4	BG 00-6-23-1-3	-
T5	BG 99-8-18-1-1	-
T6	BG 99-8-18-1-3-1	-
T6	BG 99-8-18-1-3-2	-
T6	BG 99-8-18-1-6	-
T7	BG 99-8-18-1-4-1	-
T7	BG 99-8-18-1-4-2	-

Symbols: +, positive; -, negative; N, no data

Table 15 (continued). Results of the *Gelatin Liquefaction Test*.

Grp	Isolate Number	Result
T9	BG 00-7-5-1-2-1	-
T9	BG 00-7-5-1-2-3	-
T10	BG 00-6-26-2-2-1	-
T11	BG 00-7-30-1-1	-
T11	BG 00-7-30-1-2	-
T11	BG 00-7-30-1-C	-
T11	BG 00-8-15-1-1	-
N1	BG 98-8-14-1-2-1	-
N1	BG 98-8-14-1-3-3	-
N1	BG 98-8-14-1-4-3	-
N2	BG 98-8-14-1-3-1	-
N3	BG 98-8-14-1-3-2	-
N3	BG 98-8-14-1-4-2	-
N4	BG 98-8-14-1-4-1	-
C1	BG 98-12-9-2-1	-
C1	BG 98-12-9-2-2-1	-
C1	BG 98-12-9-2-2-2	-
C2	BG 99-2-5-7-1-1	-
C2	BG 99-2-5-7-1-2	-
C2	BG 99-2-5-7-1-3	-
S1	BG 98-8-5-1-1	-
M1	BG 99-11-14-1-4-1	-
M2	BG 99-11-14-1-4-2	-
D1	BG 99-11-14-5-2-1	-
D1	BG 99-11-14-8-2-1	-
D1	BG 99-11-14-8-3-1	-
D2	BG 99-11-14-7-C	-

Symbols: +, positive; -, negative; N, no data

Table 16. Results of the *Diazonium Blue B Reaction Test.*

Grp	Number	Red Color
E1	BG 98-8-25-1-2	-
E1	BG 98-8-25-1-4	-
E1	BG 98-8-25-1-5	-
E1	BG 98-9-24-2-1	-
E2	BG 99-6-12-1-1	-
E3	BG 99-8-11-1-1	-
E3	BG 99-8-11-1-2-1	-
E3	BG 99-8-11-1-2-3	-
E3	BG 99-8-11-1-3	-
E4	BG 99-8-11-1-2-2	-
E4	BG 99-8-11-1-2-4	-
E4	BG 00-6-14-1-1	-
E4	BG 00-6-14-1-2	-
E4	BG 00-6-14-1-3	-
E4	BG 00-6-14-2-1	-
E4	BG 00-6-14-2-2	-
E4	BG 00-6-14-2-3	-
E5	BG 99-8-11-1-4-1	-
E6	BG 99-8-11-1-4-2	-
E7	BG 99-8-11-1-C1	-
E8	BG 99-8-11-1-C2	-
E9	BG 99-11-14-10-1-1	-
E9	BG 99-11-14-10-2-1	-
E9	BG 99-11-14-10-3-1	-
E9	BG 99-11-14-10-3-2	-
E9	BG 99-11-14-11-1-1	-
E9	BG 99-11-14-11-4-1	-
E9	BG 99-11-14-11-5-1	-
E10	BG 99-11-14-10-4-1	-
E12	BG 00-8-15-4-1	-

Grp	Number	Red Color
T1	BG 98-8-18-2	-
T1	BG 98-12-9-1-1	-
T1	BG 98-12-9-1-3	-
T1	BG 99-2-5-2-1-1	-
T1	BG 99-2-5-2-1-2	-
T1	BG 99-3-22-1-1	-
T1	BG 99-3-22-1-2	-
T1	BG 99-3-22-1-3	-
T1	BG 99-3-22-1-4	-
T1	BG 99-9-28-1-4	-
T1	BG 00-6-7-1-1	-
T1	BG 00-6-7-1-2	-
T2	BG 98-12-9-1-2	+
T3	BG 98-9-24-3-1	+
T3	BG 98-9-24-3-2	+
T4	BG 98-9-2-2-4	-
T4	BG 00-6-23-2-1	-
T4	BG 00-6-23-2-2	-
T4	BG 00-6-26-1-2-1	-
T4	BG 00-6-26-1-2-2	-
T4	BG 00-6-26-1-2-3	-
T4	BG 00-7-5-1-2-2	-
T4	BG 00-7-5-1-3-1	-
T4	BG 00-7-5-1-3-2	-
T4	BG 00-7-5-1-4-1	-
T4	BG 00-7-5-1-4-2	-
T4	BG 00-6-23-1-1	-
T4	BG 00-6-23-1-2	-
T4	BG 00-6-23-1-3	-
T5	BG 99-8-18-1-1	-
T6	BG 99-8-18-1-3-1	-
T6	BG 99-8-18-1-3-2	-
T6	BG 99-8-18-1-6	-
T7	BG 99-8-18-1-4-1	-
T7	BG 99-8-18-1-4-2	-

Symbols: +, positive (red color developed); -, negative (red color did not develop)

Table 16 (continued). Results of the *Diazonium Blue B Reaction Test*.

Grp	Isolate Number	Red Color
T9	BG 00-7-5-1-2-1	-
T9	BG 00-7-5-1-2-3	-
T10	BG 00-6-26-2-2-1	-
T11	BG 00-7-30-1-1	-
T11	BG 00-7-30-1-2	-
T11	BG 00-7-30-1-C	-
T11	BG 00-8-15-1-1	-
N1	BG 98-8-14-1-2-1	-
N1	BG 98-8-14-1-3-3	-
N1	BG 98-8-14-1-4-3	-
N2	BG 98-8-14-1-3-1	-
N3	BG 98-8-14-1-3-2	-
N3	BG 98-8-14-1-4-2	-
N4	BG 98-8-14-1-4-1	-
C1	BG 98-12-9-2-1	-
C1	BG 98-12-9-2-2-1	-
C1	BG 98-12-9-2-2-2	-
C2	BG 99-2-5-7-1-1	-
C2	BG 99-2-5-7-1-2	-
C2	BG 99-2-5-7-1-3	-
S1	BG 98-8-5-1-1	-
M1	BG 99-11-14-1-4-1	-
M2	BG 99-11-14-1-4-2	-
D1	BG 99-11-14-5-2-1	-
D1	BG 99-11-14-8-2-1	-
D1	BG 99-11-14-8-3-1	-
D2	BG 99-11-14-7-C	-

Symbols: +, positive (red color developed); -, negative (red color did not develop)

Table 17. Summary of Tests which Indicate the Phlyum of Isolated Yeasts.

Grp	Isolate Number	Phylum	Test[a]	
			Urea	DBB
E1	BG 98-8-25-1-2	Ascommycota	-	-
E1	BG 98-8-25-1-4	Ascommycota	-	-
E1	BG 98-8-25-1-5	Ascommycota	-	-
E1	BG 98-9-24-2-1	Ascommycota	-	-
E2	BG 99-6-12-1-1	Ascommycota	-	-
E3	BG 99-8-11-1-1	Ascommycota	-	-
E3	BG 99-8-11-1-2-1	Ascommycota	-	-
E3	BG 99-8-11-1-2-3	Ascommycota	-	-
E3	BG 99-8-11-1-3	Ascommycota	-	-
E4	BG 99-8-11-1-2-2	Ascommycota	-	-
E4	BG 99-8-11-1-2-4	Ascommycota	-	-
E4	BG 00-6-14-1-1	Ascommycota	-	-
E4	BG 00-6-14-1-2	Ascommycota	-	-
E4	BG 00-6-14-1-3	Ascommycota	-	-
E4	BG 00-6-14-2-1	Ascommycota	-	-
E4	BG 00-6-14-2-2	Ascommycota	-	-
E4	BG 00-6-14-2-3	Ascommycota	-	-
E5	BG 99-8-11-1-4-1	Ascommycota	-	-
E6	BG 99-8-11-1-4-2	Ascommycota	-	-
E7	BG 99-8-11-1-C1	Ascommycota	-	-
E8	BG 99-8-11-1-C2	Ascommycota	-	-
E9	BG 99-11-14-10-1-1	Ascommycota	-	-
E9	BG 99-11-14-10-2-1	Ascommycota	-	-

[a]Abbreviations: Urea, Results of the *Hydrolysis of Urea Test*; DBB, Results of the *Diazonium Blue B Test*

Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; -, negative

Table 17 (continued). Summary of Tests which Indicate the Phlyum of Isolated Yeasts.

Grp	Isolate Number	Phylum	Test[a]	
			Urea	DBB
E9	BG 99-11-14-10-3-1	Ascommycota	-	-
E9	BG 99-11-14-10-3-2	Ascommycota	-	-
E9	BG 99-11-14-11-1-1	Ascommycota	-	-
E9	BG 99-11-14-11-4-1	Ascommycota	-	-
E9	BG 99-11-14-11-5-1	Ascommycota	-	-
E10	BG 99-11-14-10-4-1	Ascommycota	-	-
E12	BG 00-8-15-4-1	Ascommycota	-	-
T1	BG 98-8-18-2	Ascommycota	-	-
T1	BG 98-12-9-1-1	Ascommycota	-	-
T1	BG 98-12-9-1-3	Ascommycota	-	-
T1	BG 99-2-5-2-1-1	Ascommycota	-	-
T1	BG 99-2-5-2-1-2	Ascommycota	-	-
T1	BG 99-2-5-2-2-1	Ascommycota	-	-
T1	BG 99-3-22-1-1	Ascommycota	-	-
T1	BG 99-3-22-1-2	Ascommycota	-	-
T1	BG 99-3-22-1-3	Ascommycota	-	-
T1	BG 99-3-22-1-4	Ascommycota	-	-
T1	BG 99-9-28-1-4	Ascommycota	-	-
T1	BG 00-6-7-1-1	Ascommycota	-	-
T1	BG 00-6-7-1-2	Ascommycota	-	-
T2	BG 98-12-9-1-2	Basidiomycota	+	+
T3	BG 98-9-24-3-1	Basidiomycota	w	+
T3	BG 98-9-24-3-2	Basidiomycota	+	+
T4	BG 98-9-2-2-4	Ascommycota	-	-
T4	BG 00-6-23-2-1	Ascommycota	-	-

[a]Abbreviations: Urea, Results of the *Hydrolysis of Urea Test*; DBB, Results of the *Diazonium Blue B Test*
Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; -, negative

Table 17 (continued). Summary of Tests which Indicate the Phlyum of Isolated Yeasts.

Grp	Isolate Number	Phylum	Test[a]	
			Urea	DBB
T4	BG 00-6-23-2-2	Ascommycota	-	-
T4	BG 00-6-26-1-2-1	Ascommycota	-	-
T4	BG 00-6-26-1-2-2	Ascommycota	-	-
T4	BG 00-6-26-1-2-3	Ascommycota	-	-
T4	BG 00-7-5-1-2-2	Ascommycota	-	-
T4	BG 00-7-5-1-3-1	Ascommycota	-	-
T4	BG 00-7-5-1-3-2	Ascommycota	-	-
T4	BG 00-7-5-1-4-1	Ascommycota	-	-
T4	BG 00-7-5-1-4-2	Ascommycota	-	-
T4	BG 00-6-23-1-1	Ascommycota	-	-
T4	BG 00-6-23-1-2	Ascommycota	-	-
T4	BG 00-6-23-1-3	Ascommycota	-	-
T5	BG 99-8-18-1-1	Ascommycota	-	-
T6	BG 99-8-18-1-3-1	Ascommycota	-	-
T6	BG 99-8-18-1-3-2	Ascommycota	-	-
T6	BG 99-8-18-1-6	Ascommycota	-	-
T7	BG 99-8-18-1-4-1	Ascommycota	-	-
T7	BG 99-8-18-1-4-2	Ascommycota	-	-
T9	BG 00-7-5-1-2-1	Ascommycota	-	-
T9	BG 00-7-5-1-2-3	Ascommycota	-	-
T10	BG 00-6-26-2-2-1	Ascommycota	-	-
T11	BG 00-7-30-1-1	Ascommycota	-	-
T11	BG 00-7-30-1-2	Ascommycota	-	-
T11	BG 00-7-30-1-C	Ascommycota	-	-
T11	BG 00-8-15-1-1	Ascommycota	-	-

[a]Abbreviations: Urea, Results of the *Hydrolysis of Urea Test*; DBB, Results of the *Diazonium Blue B Test*

Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; -, negative

Table 17 (continued). Summary of Tests which Indicate the Phlyum of Isolated Yeasts.

Grp	Isolate Number	Phylum	Test[a]	
			Urea	DBB
N1	BG 98-8-14-1-2-1	Ascommycota	-	-
N1	BG 98-8-14-1-3-3	Ascommycota	-	-
N1	BG 98-8-14-1-4-3	Ascommycota	-	-
N2	BG 98-8-14-1-3-1	Ascommycota	-	-
N3	BG 98-8-14-1-3-2	Ascommycota	-	-
N3	BG 98-8-14-1-4-2	Ascommycota	-	-
N4	BG 98-8-14-1-4-1	Ascommycota	-	-
C1	BG 98-12-9-2-1	Ascommycota	-	-
C1	BG 98-12-9-2-2-1	Ascommycota	-	-
C1	BG 98-12-9-2-2-2	Ascommycota	-	-
C2	BG 99-2-5-7-1-1	Ascommycota	-	-
C2	BG 99-2-5-7-1-2	Ascommycota	-	-
C2	BG 99-2-5-7-1-3	Ascommycota	-	-
S1	BG 98-8-5-1-1	Ascommycota	-	-
M1	BG 99-11-14-1-4-1	Ascommycota	-	-
M2	BG 99-11-14-1-4-2	Ascommycota	-	-
D1	BG 99-11-14-5-2-1	Ascommycota	-	-
D1	BG 99-11-14-8-2-1	Ascommycota	-	-
D1	BG 99-11-14-8-3-1	Ascommycota	-	-
D2	BG 99-11-14-7-C	Ascommycota	-	-

[a]Abbreviations: Urea, Results of the *Hydrolysis of Urea Test*; DBB, Results of the *Diazonium Blue B Test*
Symbols: +, positive; l, latently positive; s, slowly positive; w, weak; -, negative

DISCUSSION

The assimilation tests provided essential information for yeast identification and characterization. Molecular data and morphological data confirm that almost all of the yeast isolates are ascomycetes. Results of two tests, *hydrolysis of urea* and *diazonium blue b color reaction*, support this conclusion. Most of the tested isolates were negative for the *hydrolysis of urea* and *diazonium blue b color reaction* tests, indicating that many of the yeast isolates are best grouped by the phylum *Ascomycota* (Table 17).

It has been established previously that the enzyme urease catalyses the hydrolysis of urea in basidiomycetous yeasts to yield ammonia and carbamate (Yarrow 1998). Carbamate hydrolyzes into carbonic acid and another molecule of ammonia, with the overall reaction leading to an increase in pH (Yarrow 1998).

Ability to hydrolyze urea is generally absent in ascomycetes, which is shown in Table 17. None of the isolates except the T2 and T3 groups hydrolyzed urea, which is a mark of basidiomycetous genera and not ascomycetous yeasts (Tables 13 & 17). Yet since a few ascomycetous yeasts that have been reported to hydrolyze urea (Yarrow 1998) the results of the *diazonium blue b color reaction* test were used to support their identity as basidiomycetes.

Groups T2 and T3 were did give a positive reaction in the *diazonium blue b color reaction* test (Table 16 & Table 17). Although the mechanism of this reaction has not yet been reported, it appears to be consistent in determining whether a yeast strain is a basidiomycete or ascomycete. It has been reported that "all strains of basidiomycetous yeasts, as well as those anamorphs which had cell walls with a fine structure typical of basidiomycetes, gave a dark-red color reaction when a buffered solution of diazonium blue b was applied to

the cultures" (Yarrow 1998). Since ascomycete species have never been reported to yield a positive reaction to this test, the T2 and T3 grouped yeasts most likely belong to the phylum *Basidiomycota,* unlike the other 93 isolates tested.

It was also characteristic of most isolates grouped by their 26 rDNA to exhibit the same responses in other assimilation tests, such as the *assimilation tests of carbon compounds* and the *fermentation of carbohydrates tests*. Yeast isolates were able to utilize a significant number of the tested carbon compounds as their sole energy source. This ability may play a role in aiding beetles in obtaining energy from these sources.

Because of the ability of yeasts to ferment sugars and because of their position in the beetle mid gut, it is possible that there are anaerobic regions of the beetle gut where fermentative respiration could occur. Most yeasts require an abundance of oxygen for growth, but some can ferment sugars to alcohol and carbon dioxide in the absence of oxygen. Fermentation results in production ethyl alcohol and carbon dioxide from simple sugars such as glucose and fructose.

In a few cases deviation from the expected behavior of isolate groups in the *assimilation tests of carbon compounds* and the *fermentation of carbohydrates test* may have been due to contamination of the medium (Tables 5 & 6), which can lead to falsely positive results in these tests (Yarrow 1998). It must also be noted that it has been found that the results of *assimilation tests of carbon compounds* may be improved by continuous shaking of the tubes during incubation (Yarrow 1998). Since agitation of the tubes in this experiment was only done periodically, this may be another source of skewed data.

Under conditions of excess oxygen, the alcohol produced by fermentation can be oxidized to form acetic acid. Since this condition of excess oxygen may have not been met, the results of the *test for acetic acid production from glucose* might be regarded as somewhat ambiguous. Yeasts in general are known to produce small amounts of acids, but it is only when yeast species produce large amounts of acids that this test becomes valuable (Yarrow 1998), an outcome not observed in the study.

The ability of anobiid endosymbionts to grow on media with a nitrogen compound as its only energy source may suggest a recycling of the excretory products of the beetles by the yeasts (Jurzitza 1972). This recycling may have decreased the loss of nitrogen, and therefore helped the beetles to occupy a substrate with low protein content (Jurzitza 1972). This idea was confirmed by the observations of Milne (1963).

All 95 yeast strains were able to grow in the absence of at least four essential vitamins (Table 10), suggesting that the endosymbionts may supply their host with vitamins in which their diet might have been deficient. This has been confirmed under laboratory conditions by Fraenkel and Blewett (1942, 1943a, b), who reared aposymbiotic anobiid larvae in diets deficient in some of the same vitamins used in this study - thiamine, pyridoxine, and biotin. In most of the diets deficient in essential vitamins, the normal larvae was able to grow, while growth of the aposymbiotic larvae was retarded or did not grow at all (Fraenkel and Blewett 1942, 1943a, b).

Yarrow (1989) pointed out that, "Yeasts from substrates with high sugar and salt contents are usually resistant to high osmotic pressures. Many yeast stains [have been found] to grow well in glucose concentrations up to 40% by weight whereas, few species grow at

concentrations between 50 and 70%." My results showed a positive correlation between isolates able to grow at high salt and sugar concentrations and their ability to utilize the mannitol as a sole energy source in the *assimilation tests of carbon compounds.* Mannitol is known to be used in some yeasts for osmotic regulation (Yarrow 1998).

None of the yeast isolates produced starch, an indication that they did not produce capsules (Table 7). Encapsulation was, however, not expected because a pH below 5.0 is required for the process to occur, (Yarrow 1998), a condition avoided in this study.

The *test for gelatin liquefaction* may have been "of limited diagnostic value because few yeasts are strongly proteolytic" (Yarrow 1998). But the test was performed since the isolates had never before been characterized.

Despite the low diagnostic value of some of the assimilation tests, the majority of the tests provided important information for describing the new yeast isolates beyond molecular characterization. In the first place physiological and biochemical traits of the newly discovered saccharomycetalean yeasts are necessary components of their taxonomic descriptions. Secondly, the physical, biochemical, and morphological characters along with molecular data can then be combined in phylogenic analyses to expand current understanding of the evolutionary patterns of the yeast endosymbionts (Wheeler and Blackwell 1984). Lastly, of equal importance is the insight that these traits provide in trying determine the exact relationship between the beetle hosts and their presumptive endosymbionts, because it is assumed that the yeast endosymbionts are involved in the ability of the beetles to eat fungi as a sole nutrient resource. An understanding of the nutritional requirements of the yeasts inhabiting the beetles suggests

future laboratory experimentation for determining the exact nutritional advantage that the yeasts may provide for the beetles.

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