NEW YEAST SPECIES ISOLATED FROM WORLDWIDE COLD ENVIRONMENTS

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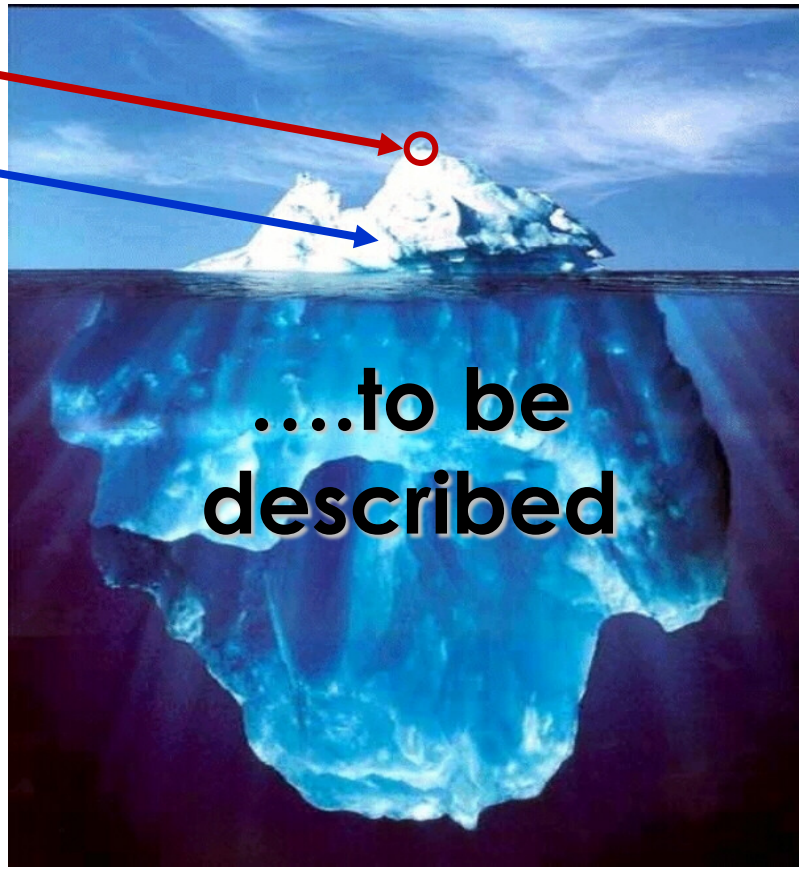
&
Industrial Yeasts Collection DBVPG
(www.dbvpg.unipg.it)

Worldwide microbial diversity

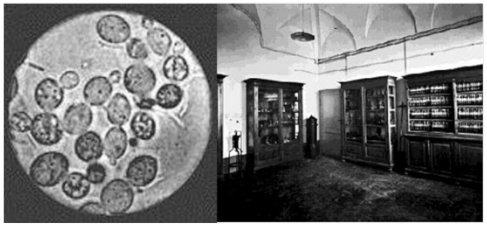
Studied in deep…

… so far described….

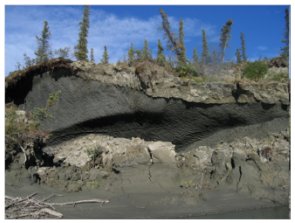
Microbial diversity represents an enormous but largely underexplored genetic and biological pool, which can be exploited for novel genes, their products and metabolic pathways.
Almost 99% of the microbial consortium of certain environments cannot be cultured by standard laboratory techniques



The long walk of the DBVPG



Food & Beverage

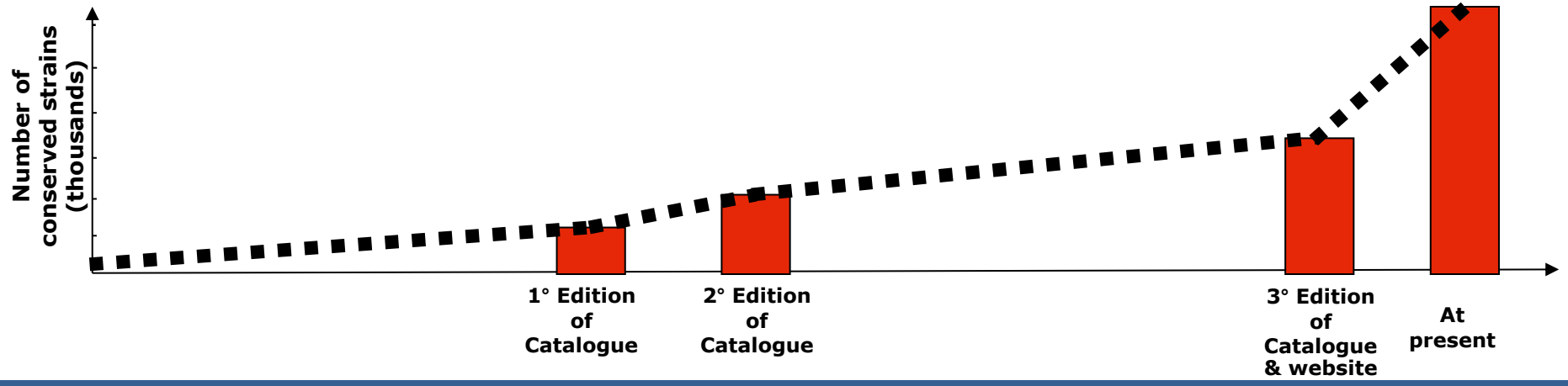


Environment

Tropical habitat

Glacial habitat

1930 1940 1950 1960 1970 1980 1990 2000 2019



Biodiversity and Ecology of Glaciers

1. Extreme habitats and scarce human presence

2. Few ecological studies related to the distribution of microorganisms (in particular yeasts)

3. The micro-organisms that colonize cold environments develop particular survival strategies (specific metabolisms and the production of particular molecules)

4. Glaciers represent an "endangered" habitat characterized by a microflora that is disappearing with it

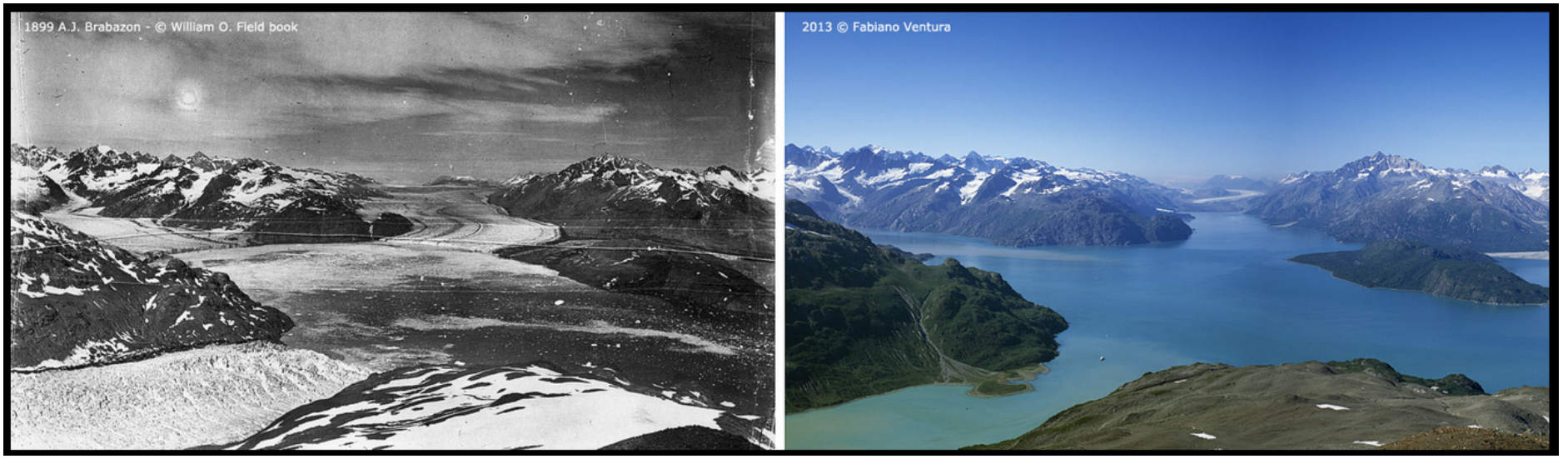
Global Warming

1941 **2013**

Muir Glacier, Alaska

Global Warming

1899 **2013**



Grand Pacific Glacier, Alaska

Global Warming

1909 **2009**

Liligo Glacier, Karakorum, Himalaya

Global Warming

1929

Baltoro Glacier, Karakorum, Himalaya

2009

Global Warming

1890 **2011**

Kitlodi Glacier, Caucaso, Georgia

Global Warming

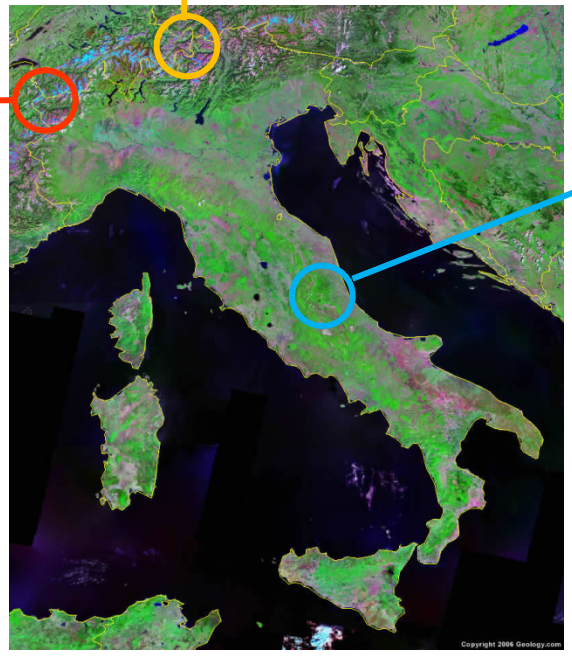
1884 **2011**

Tszaneri Glacier, Caucaso, Georgia

Sampling campaigns

Central Alps
Ortles-Cevedale
3,400 m a.s.l.
(2002-2005)

West Alps
Mont Blanc
3,600 m a.s.l.
(2008-2012)



Apennines
Gran Sasso
3,100 m a.s.l.
(2006-2008)

Sampling campaigns

Antarctica - Victoria Land (East Antarctica) 2015-2019

Samplings

snow and melting water

Ice cores

Supra and sub-glacial sediments (1-2°C *in situ*)

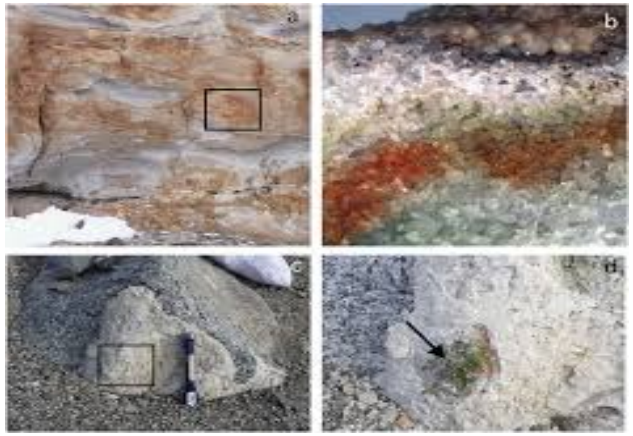
Samplings

Permafrost,

ice cores

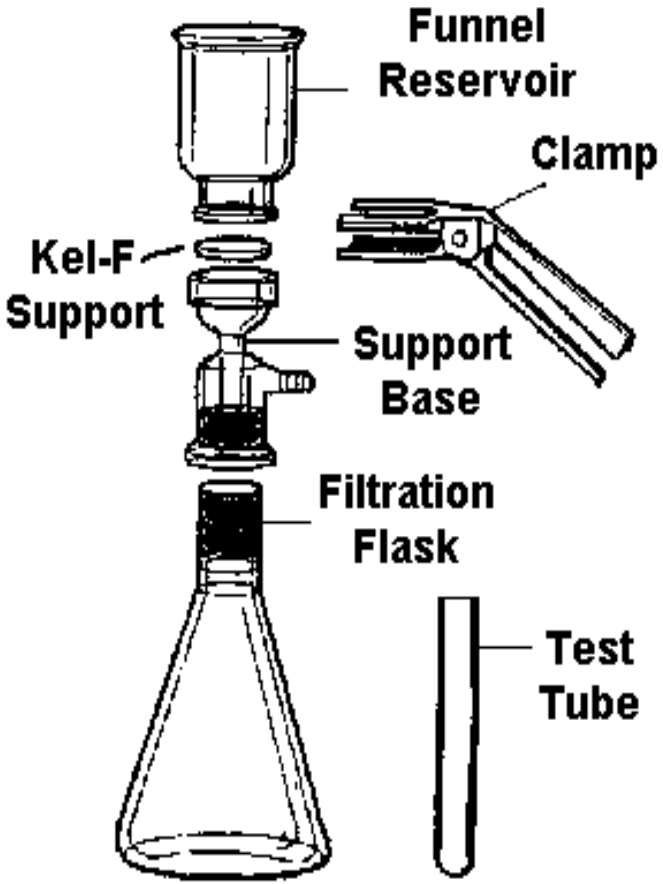
& brines

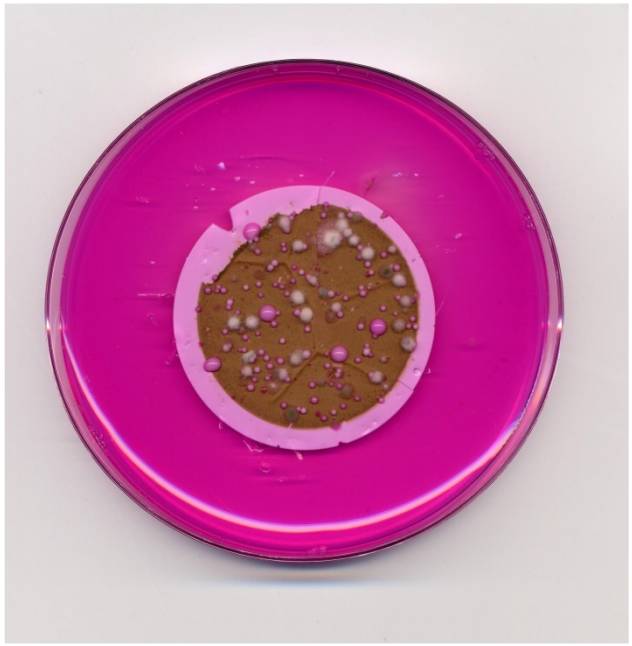
rocks



Culture-dependent microbial diversity

Water or generally liquid samples

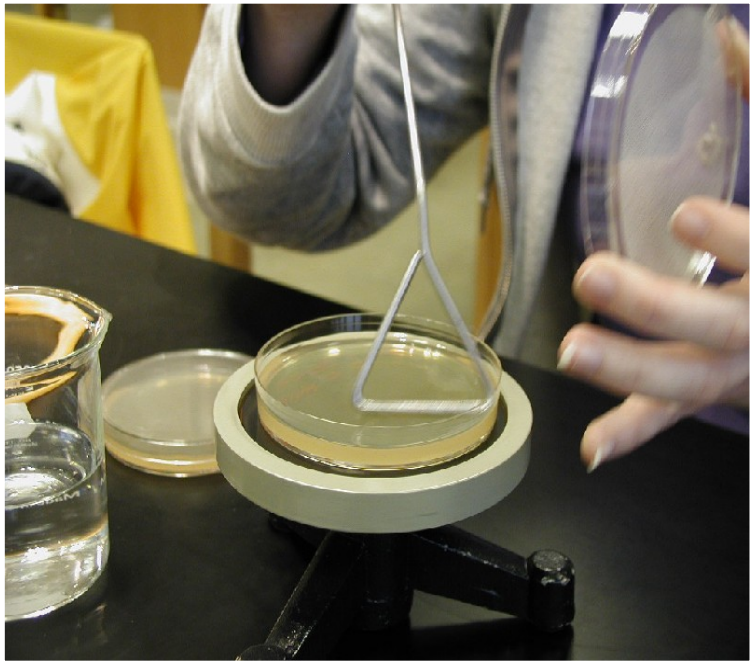


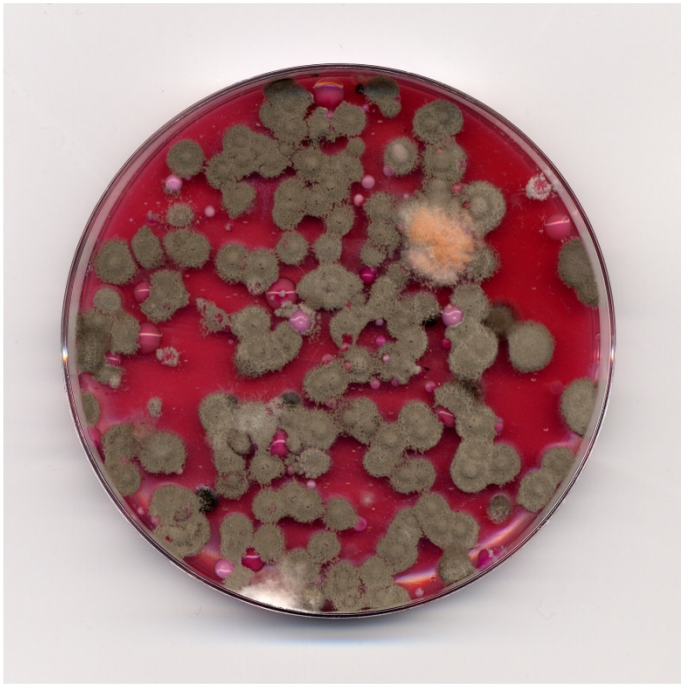


Culture-dependent microbial diversity

Solid samples

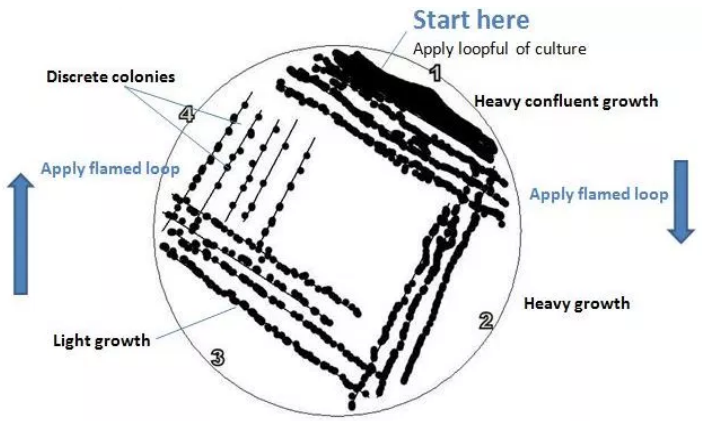
Enrichment (if necessary) and Streaking plate method

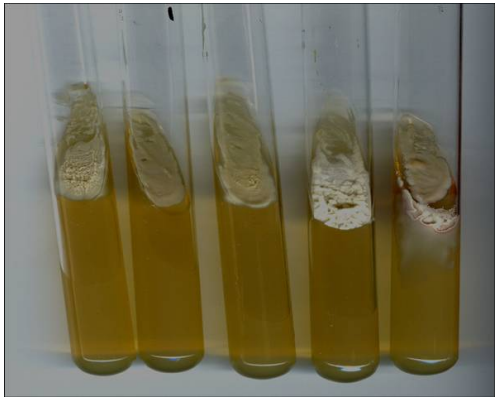




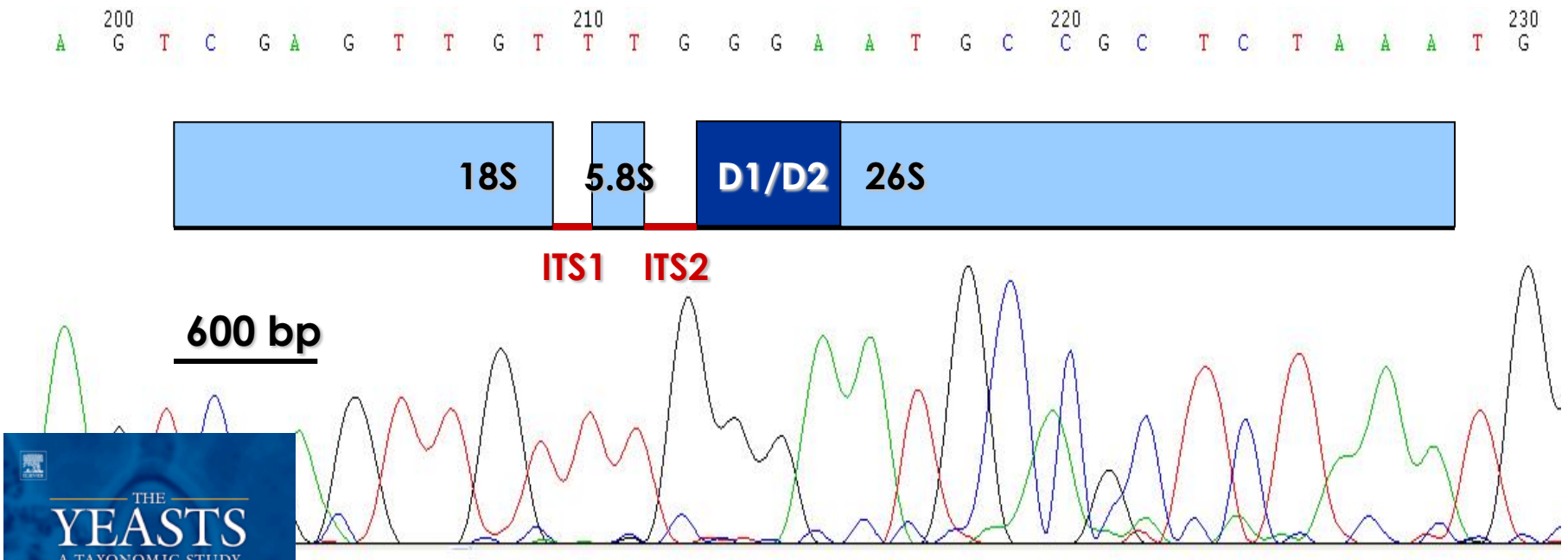
Culture-dependent microbial diversity

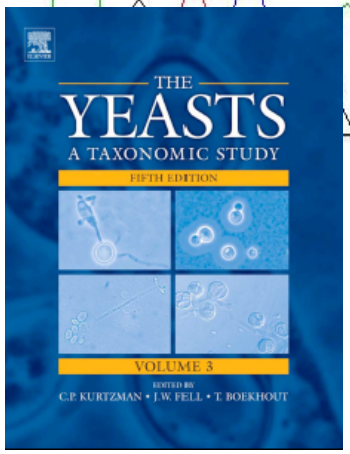
Isolation on solid medium and conservation in fresh form

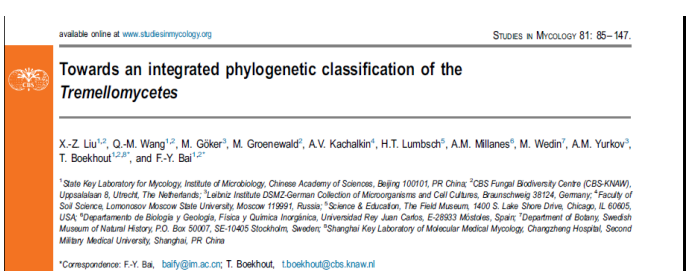




Molecular identification : sequencing of the D1/D2 domains of 26S rRNA gene and of ITS (1 & 2)







available online at www.studiesinmycology.org

STUDIES IN MYCOLOGY 81: 85–147.

Towards an integrated phylogenetic classification of the *Tremellomycetes*

X.-Z. Liu[1,2], Q.-M. Wang[1,2], M. Göker[3], M. Groenewald[2], A.V. Kachalkin[4], H.T. Lumbsch[5], A.M. Millanes[6], M. Wedin[7], A.M. Yurkov[3], T. Boekhout[1,2,8*], and F.-Y. Bai[1,2*]

[1]State Key Laboratory for Mycology, Institute of Microbiology, Chinese Academy of Sciences, Beijing 100101, PR China; [2]CBS Fungal Biodiversity Centre (CBS-KNAW), Uppsalalaan 8, Utrecht, The Netherlands; [3]Leibniz Institute DSMZ-German Collection of Microorganisms and Cell Cultures, Braunschweig 38124, Germany; [4]Faculty of Soil Science, Lomonosov Moscow State University, Moscow 119991, Russia; [5]Science & Education, The Field Museum, 1400 S. Lake Shore Drive, Chicago, IL 60605, USA; [6]Departamento de Biología y Geología, Física y Química Inorgánica, Universidad Rey Juan Carlos, E-28933 Móstoles, Spain; [7]Department of Botany, Swedish Museum of Natural History, P.O. Box 50007, SE-10405 Stockholm, Sweden; [8]Shanghai Key Laboratory of Molecular Medical Mycology, Changzheng Hospital, Second Military Medical University, Shanghai, PR China

*Correspondence: F.-Y. Bai, baify@im.ac.cn; T. Boekhout, t.boekhout@cbs.knaw.nl

available online at www.studiesinmycology.org

STUDIES IN MYCOLOGY 81: 149–189.

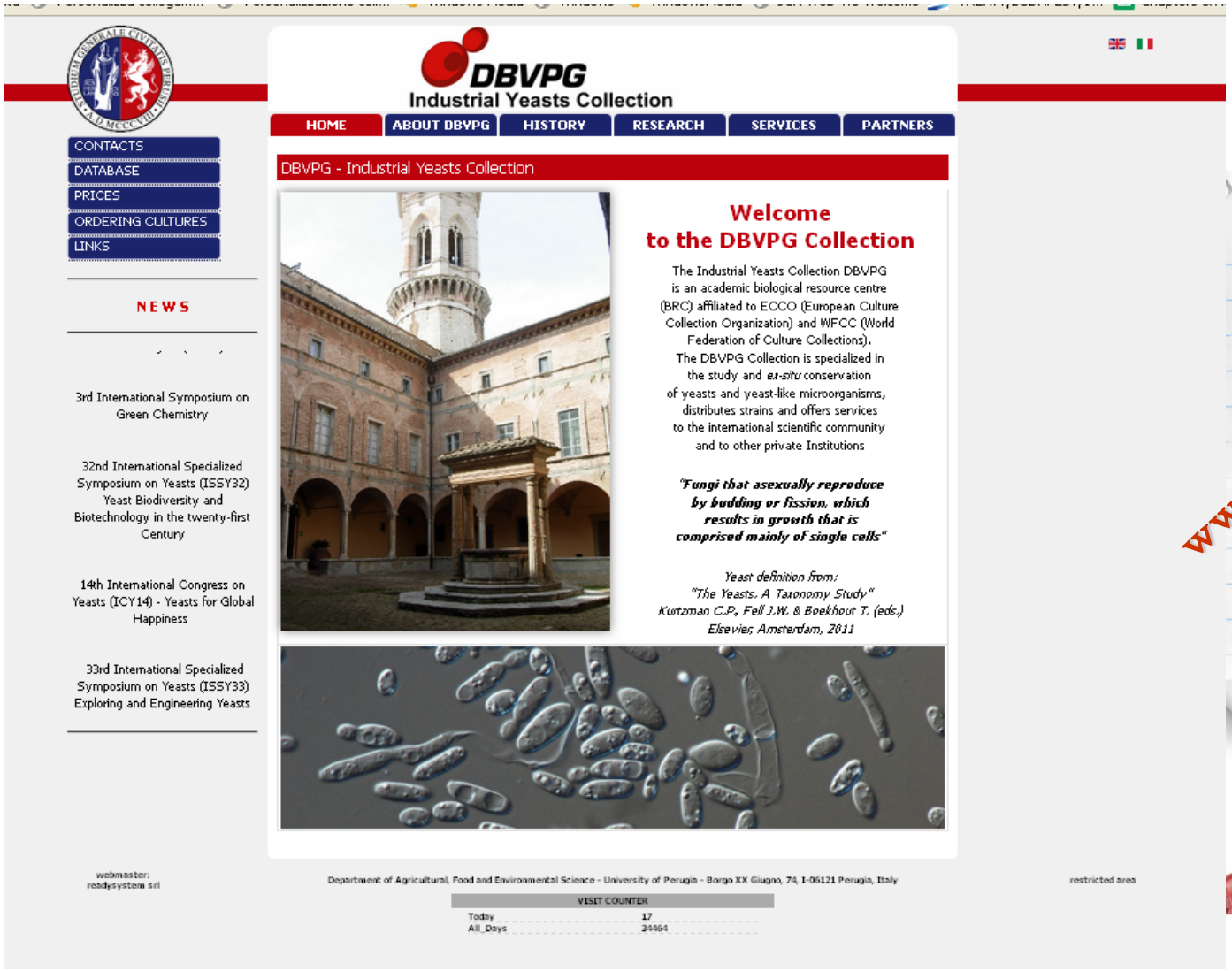
Phylogenetic classification of yeasts and related taxa within *Pucciniomycotina*

Q.-M. Wang[1], A.M. Yurkov[2], M. Göker[2], H.T. Lumbsch[3], S.D. Leavitt[3], M. Groenewald[4], B. Theelen[4], X.-Z. Liu[1], T. Boekhout[1,4,5*], and F.-Y. Bai[1,4*]

[1]State Key Laboratory of Mycology, Institute of Microbiology, Chinese Academy of Sciences, Beijing 100101, China; [2]Leibniz Institute DSMZ – German Collection of Microorganisms and Cell Cultures, Braunschweig, Germany; [3]Science & Education, The Field Museum, 1400 S. Lake Shore Drive, Chicago, IL 60605, USA; [4]CBS Fungal Biodiversity Centre (CBS–KNAW), Uppsalalaan 8, 3584 CT Utrecht, The Netherlands; [5]Shanghai Key Laboratory of Molecular Medical Mycology, Changzheng Hospital, Second Military Medical University, Shanghai, China

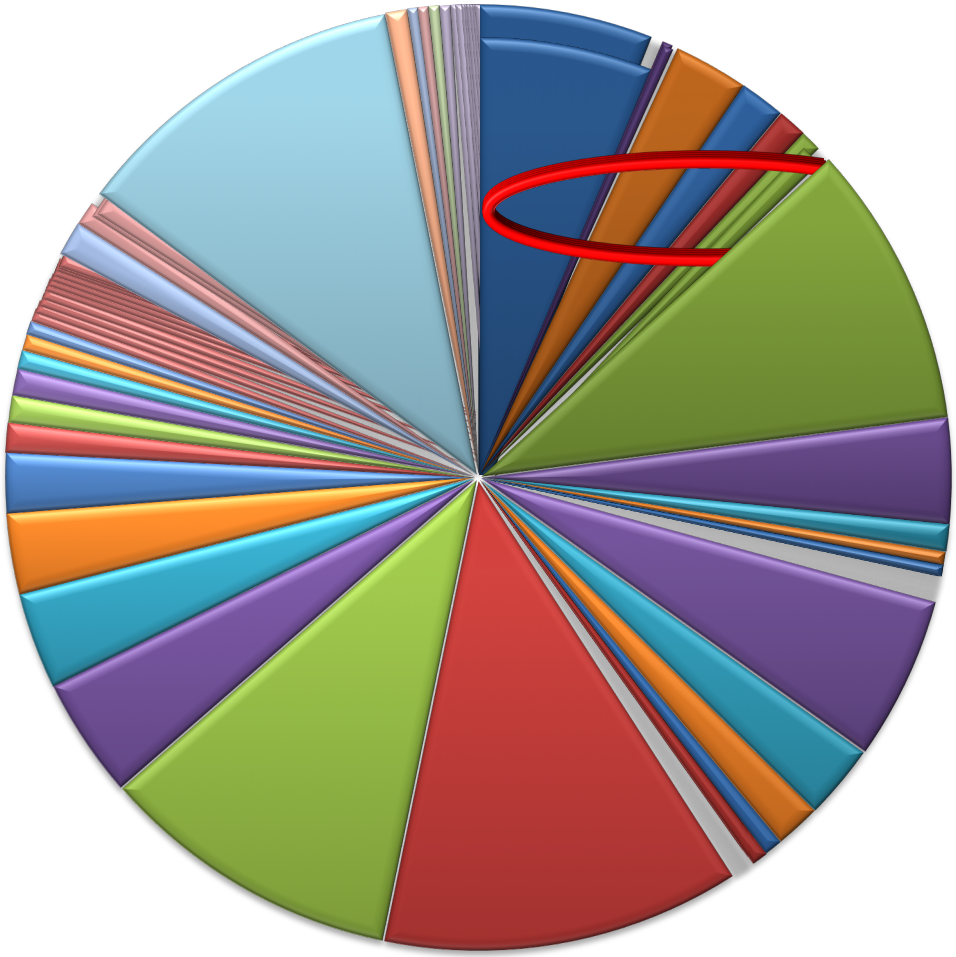
*Correspondence: T. Boekhout, t.boekhout@cbs.knaw.nl; F.-Y. Bai, baify@im.ac.cn

Ex-situ conservation



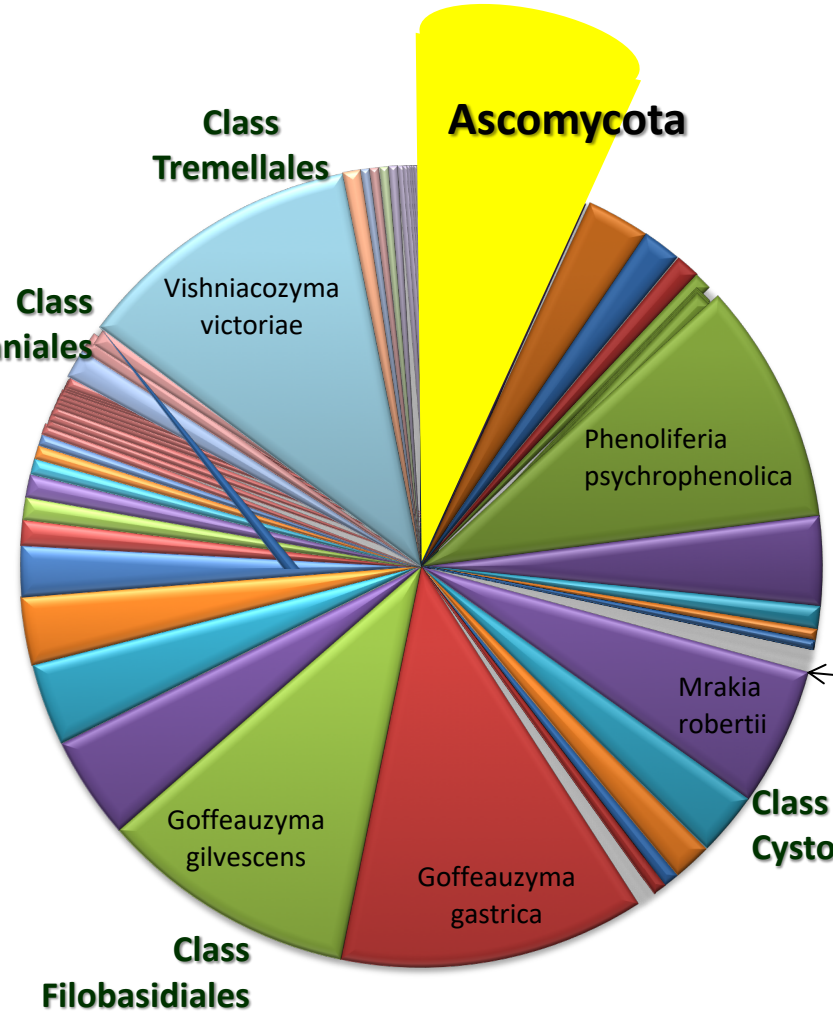
Isolated biodiversity

1088 strains belonging to 78 species



- Aureobasidium pullulans
- Exophiala dermatitidis
- Candida sp.
- Cystobasidium laryngis
- Cystobasidium cf. laryngis
- Cystobasidium sp.
- Buckleyzyma aurantiaca
- Phenoliferia psychrophenolica
- Sporobolomyces roseus
- Glaciozyma watsonii
- Rhodosporidiobolus colostri
- Leucosporidium intermedium
- Phenoliferia sp.
- Rhodotorula bacarum
- Mrakia gelida
- Mrakia aquatica
- Mrakia cf. gelida
- Itersonilia pannonica
- Mrakia niccombsii
- Goffeauzyma gilvescens
- Solicoccozyma terricola
- Naganishia cf. antarctica
- Filobasidium stepposus
- Filobasidium sp.
- Filobasidium magnus
- Filobasidium chernovii
- Naganishia albidosimilis
- Naganishia cf. albida
- Naganishia friedmannii
- Heterocephalacria sp.
- Holtermanniella takashimae
- Holtermanniella festucosa
- Vishniacozyma victoriae
- Dioszegia crocea
- Dioszegia sp. 1
- Bulleromyces albus
- Dioszegia fristingensis
- Papiliotrema laurentii
- Vishniacozyma cf. tephrensis
- Aureobasidium sp.
- Candida santamariae
- Cystofilobasidium macerans
- Cystofilobasidium capitatum
- Cystobasidium sp.
- Cystofilobasidium infirmominiatum
- Erythrobasidium hasegawianum
- Phenoliferia glacialis
- Ustilentyloma graminis
- Leucosporidium creatinivorum
- Glaciozyma martinii
- Leucosporidium sp.
- Sporobolomyces metaroseus
- Mrakia robertii
- Tausonia pullulans
- Mrakia cryoconiti
- Mrakia psychrophila
- Mrakia blollopis
- Goffeauzyma gastrica
- Naganishia vaughanmartiniae
- Naganishia adeliensis
- Filobasidium wieringae
- Naganishia antarctica
- Solicoccozyma aeria
- Naganishia albida
- Filobasidium oeirense
- Naganishia globosa
- Naganishia diffluens
- Solicoccozyma terreus
- Solicoccozyma fuscescens
- Holtermanniella wattica
- Holtermanniella festucosa
- Dioszegia sp. 2
- Dioszegia hungarica
- Vishniacozyma tephrensis
- Papiliotrema sp.
- Gelidatrema sp.
- Vishniacozyma carnescens
- Vishniacozyma dimennae

Isolated biodiversity



Subphylum
Pucciniomycotina
Order
Cystobasidiomycetes and
Microbotryomycetes

Subphylum
Agaricomycotina
Order
Tremellomycetes

Subphylum
Ustillagomycotina
Only one strain

Class
Cystofilobasidiales

NEW SPECIES

20% of the isolated species
were new species - never described before

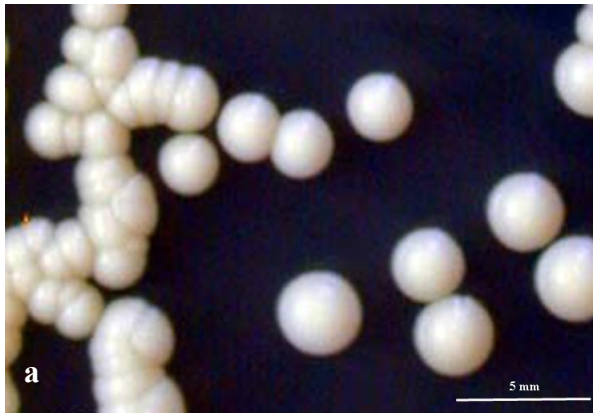
12,87% of the total strains
resulted never described before

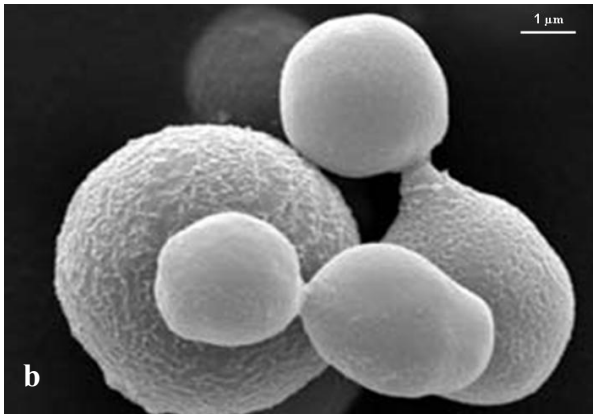
Species with characteristics such as to differentiate them from the known biodiversity

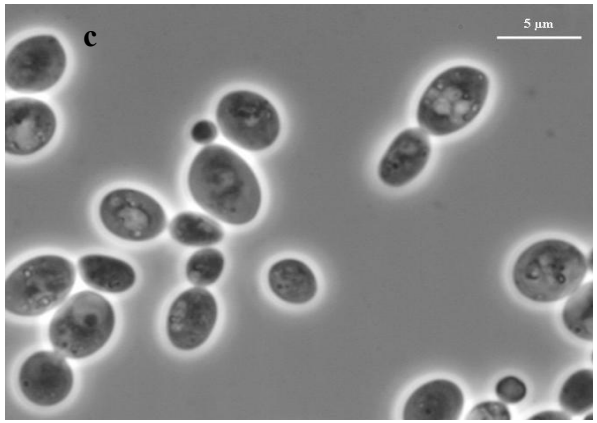
Is this reason sufficient to continue to isolate and preserve…… especially in environments that are peculiar and that are disappearing?

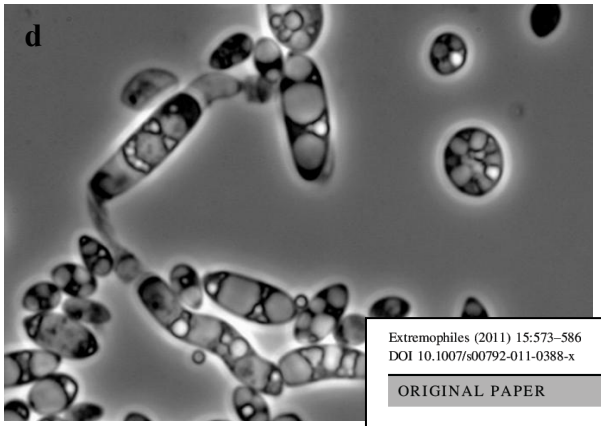
GLACIOZYMA MARTINII Turchetti, Connell, Thomas-Hall & Boekhout sp. nov.

Basidiomycota; Pucciniomycotina; Microbotryomycetes; Kriegeriales; Camptobasidiaceae









Glaciozyma martinii

Type strain: **DBVPG 8018** = CBS 10620

Origins of strains: **Antarctica, Alps**

Growth temperature: **10-15°C** (< 20°C)

Extremophiles (2011) 15:573–586
DOI 10.1007/s00792-011-0388-x

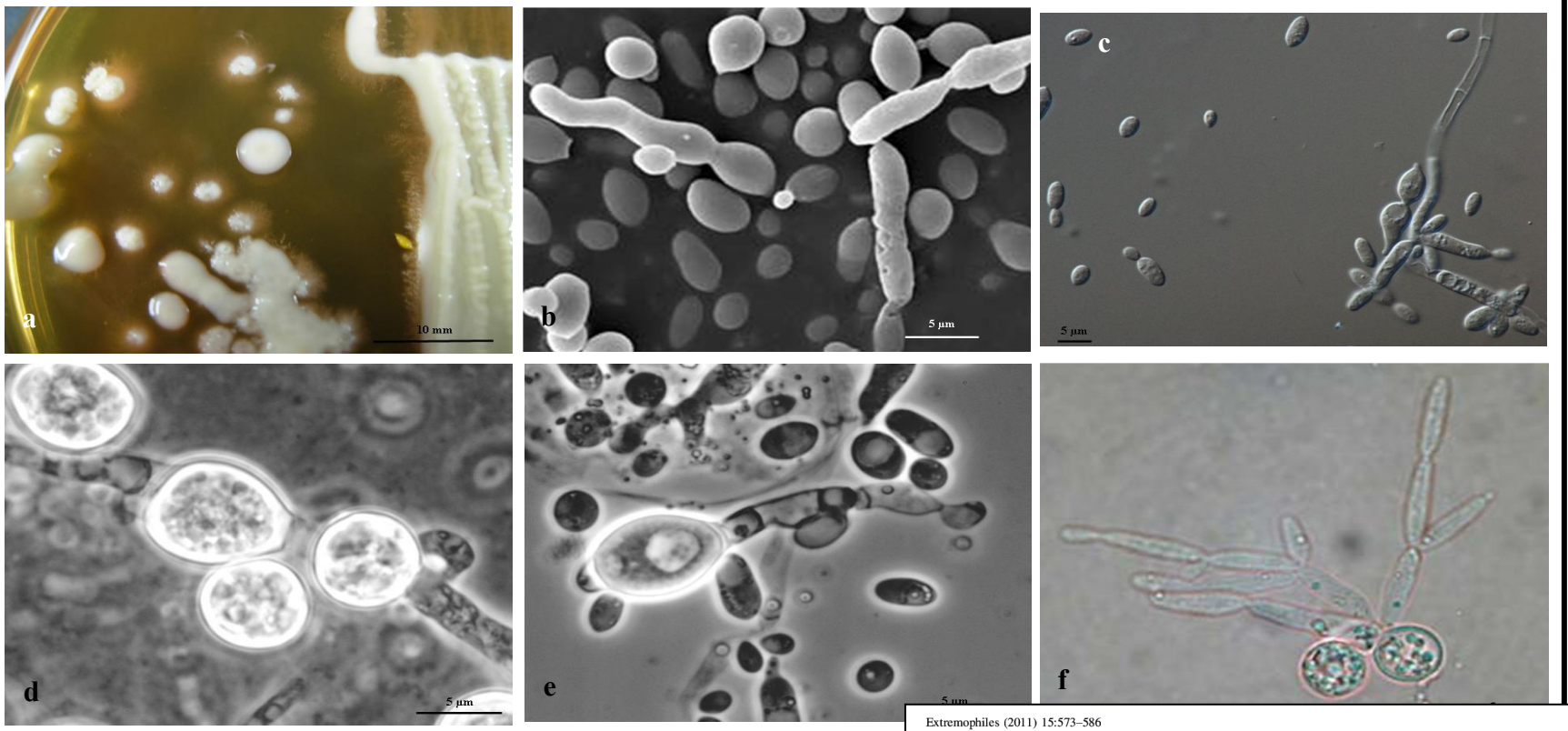
ORIGINAL PAPER

Psychrophilic yeasts from Antarctica and European glaciers: description of *Glaciozyma* gen. nov., *Glaciozyma martinii* sp. nov. and *Glaciozyma watsonii* sp. nov.

Benedetta Turchetti · Skye R. Thomas Hall · Laurie B. Connell · Eva Branda · Pietro Buzzini · Bart Theelen · Wally H. Müller · Teun Boekhout

GLACIOZYMA WATSONII Thomas-Hall, Connell, Boekhout & Turchetti sp. nov.

Basidiomycota; Pucciniomycotina; Microbotryomycetes; Kriegeriales; Camptobasidiaceae



Glaciozyma watsonii

Type strain: **DBVPG 4726** = CBS 10986

Origins of strains: **Antarctica, Alps**

Growth temperature: **10-15°C** (< 20°C)

Extremophiles (2011) 15:573–586
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CYSTOBASIDIUM ALPINUM Turchetti, Selbmann, Onofri & Buzzini sp. nov.

Basidiomycota; Pucciniomycotina; Cystobasidiomycetes; Cystobasidiales; Cystobasidiaceae

Cystobasidium alpinum

Colonies of the type strain **DBVPG 10041** on MEA after 2 weeks incubation at 15 °C. Polar budding cells of DBVPG 10041T on MEA after 1 week incubation at 15°C.

Orgin of the strains: **Alps**

Growth at **10°C, 15°C, 20°C was good, while it was delayed at 4°C and very weak at 25°C;** no growth was shown at 30°C. Optimum growth temperature is 15° C.

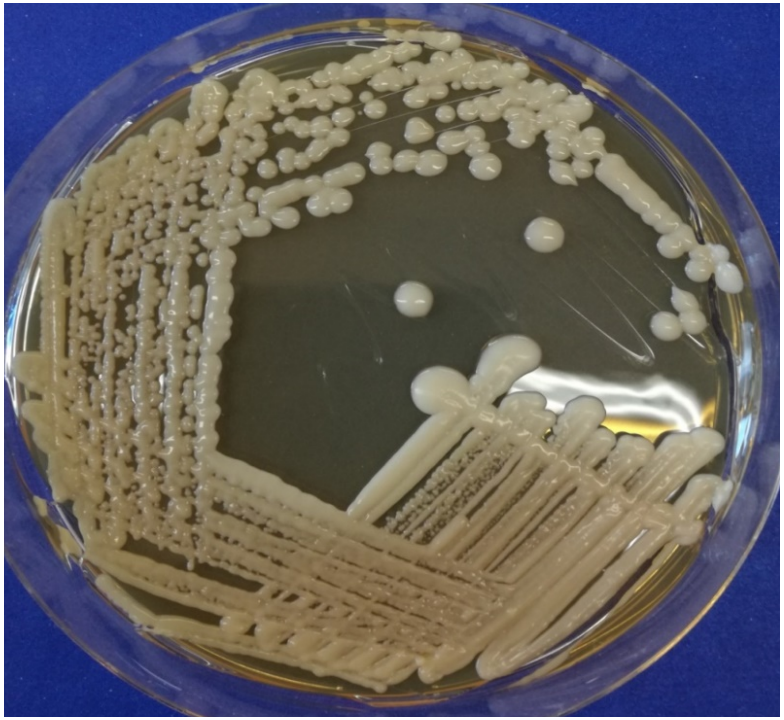
life

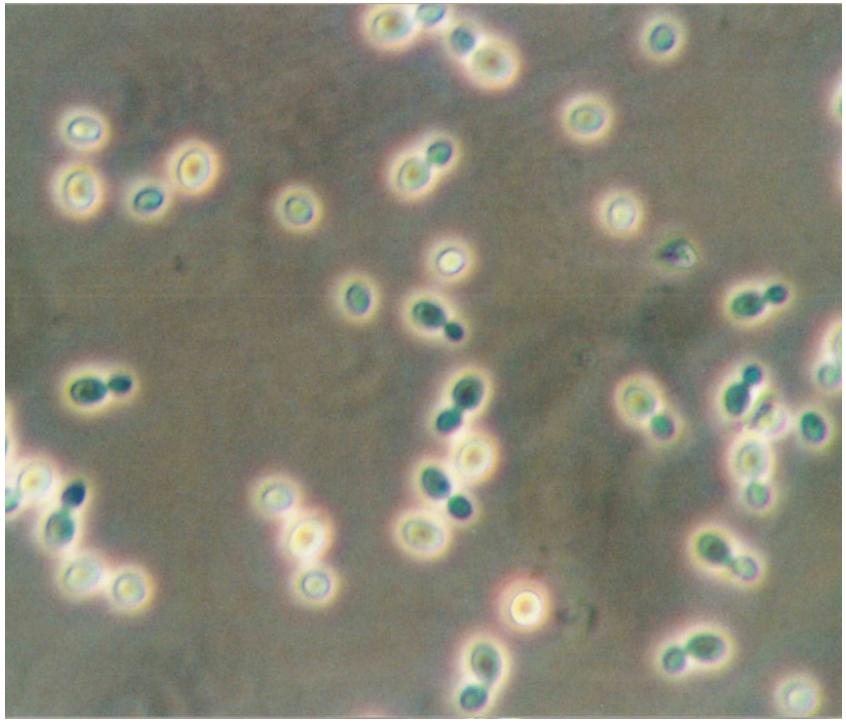
MDPI

Article

***Cystobasidium alpinum* sp. nov. and *Rhodosporidiobolus oreadorum* sp. nov. from European Cold Environments and Arctic Region**

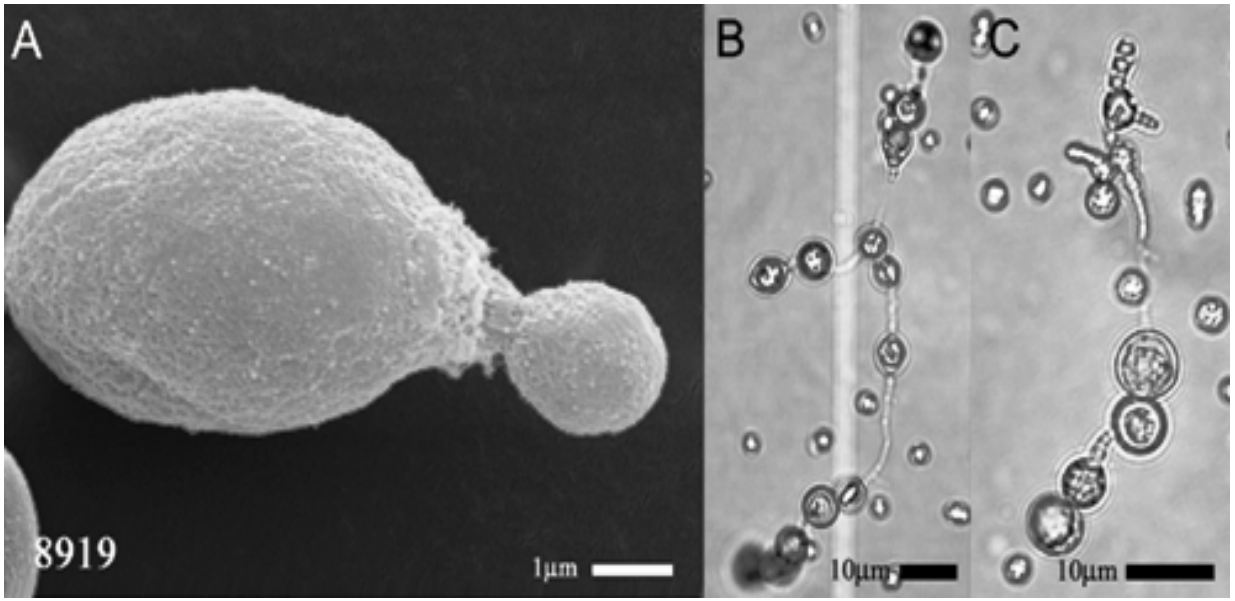
Benedetta Turchetti [1,*], Laura Selbmann [2,3], Nina Gunde-Cimerman [4], Pietro Buzzini [1], José Paulo Sampaio [5] and Polona Zalar [4]

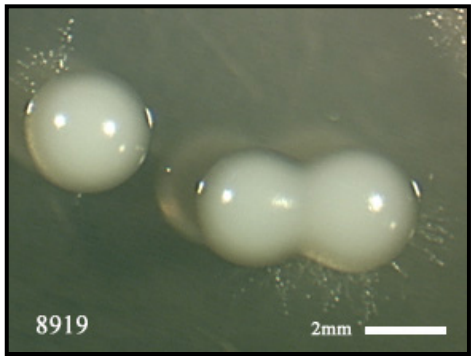


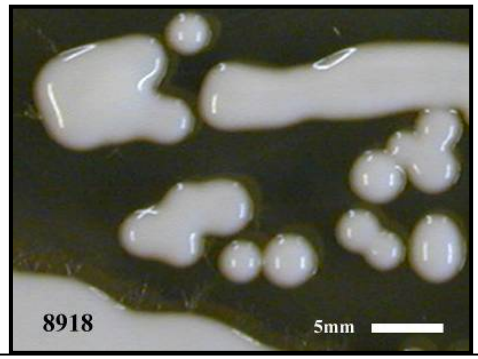


MRAKIA ROBERTII Thomas-Hall & Turchetti sp. nov.

Basidiomycota; Agaricomycotina; Tremellomycetes; Cystofilobasidiales; Mrakiaceae







Mrakia robertii
Type strain: CBS 8912
Origins of strains: **Antarctica, Alps**
YEP broth: cells ovoidal-elongate, singly or in pairs
Budding: polar
Size: 1.5-4.5 x 2-7 µm
Colonies in YEP Agar: white-cream colour, butyrous, smooth, convex, circular, with treu/pseudo hyphae
Teliospore: present, intercalary and terminally
Growth temperature: **15-18°C** (max 20°C)

Extremophiles (2010) 14:47–59
DOI 10.1007/s00792-009-0286-7

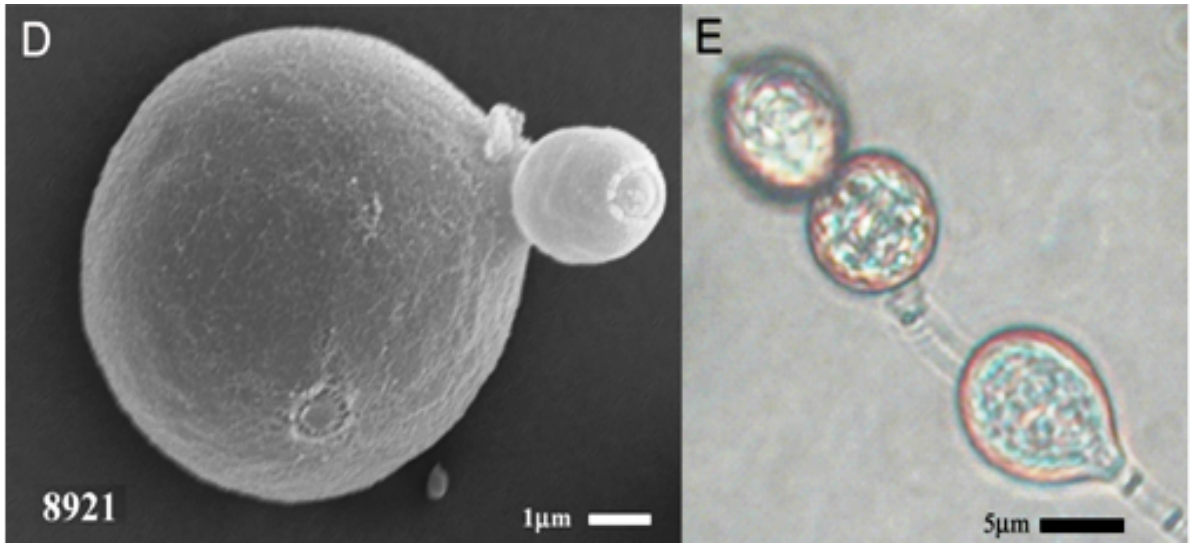
ORIGINAL PAPER

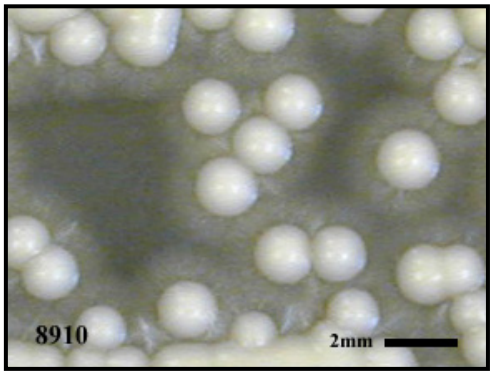
Cold-adapted yeasts from Antarctica and the Italian Alps—description of three novel species: *Mrakia robertii* sp. nov., *Mrakia blollopis* sp. nov. and *Mrakiella niccombsii* sp. nov.

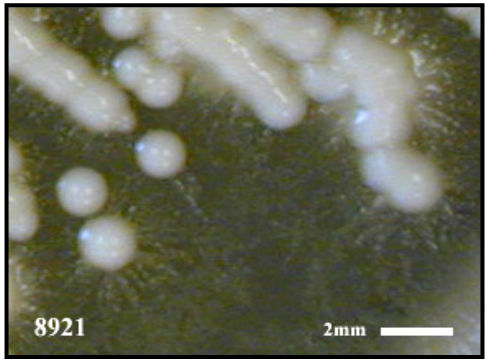
Skye Robin Thomas-Hall · Benedetta Turchetti · Pietro Buzzini · Eva Branda · Teun Boekhout · Bart Theelen · Kenneth Watson

MRAKIA BLOLLOPIS Thomas-Hall sp. nov.

Basidiomycota; Agaricomycotina; Tremellomycetes; Cystofilobasidiales; Mrakiaceae







Mrakia blollopis
Type strain: CBS 8921
Origins of strains: **Antarctica**
YEP broth: cells spheroidal to ovoidal, singly or in pairs
Budding: polar
Size: 2-4.5 x 3.5-7 µm
Colonies in YEP Agar: from white-cream to yellow-white colour, butyrous, smooth, convex, circular, with treu/pseudo hyphae
Teliospore: present, intercalary and terminally
Growth temperature: **15-18°C** (max 20°C)

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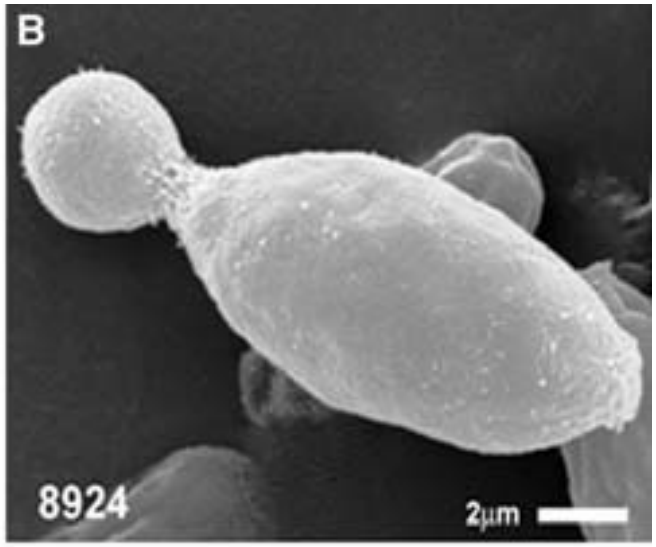
MRAKIA NICCOMBSII Thomas-Hall sp. nov.

Basidiomycota; Agaricomycotina; Tremellomycetes; Cystofilobasidiales; Mrakiaceae



Mrakia niccombsii
Type strain: CBS 8917
Origins of strains: **Antarctica**
YEP broth: cells ovoidal-elongate, singly or in pairs
Budding: polar
Size: 2-3 x 4-7 µm
Colonies in YEP Agar: white-cream colour, butyrous, smooth, convex, circular, with pseudo hyphae
Teliospore: absent
Growth temperature: **15-18°C** (max 18°C)

Extremophiles (2010) 14:47–59
DOI 10.1007/s00792-009-0286-7

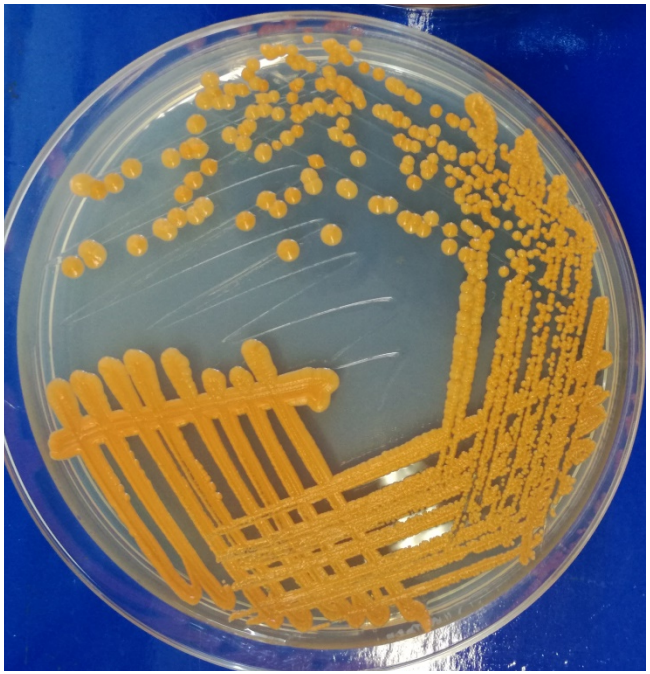
ORIGINAL PAPER

Cold-adapted yeasts from Antarctica and the Italian Alps—description of three novel species: *Mrakia robertii* sp. nov., *Mrakia blollopis* sp. nov. and *Mrakiella niccombsii* sp. nov.

Skye Robin Thomas-Hall · Benedetta Turchetti · Pietro Buzzini · Eva Branda · Teun Boekhout · Bart Theelen · Kenneth Watson

VUSTINIA TERRAE Kachalkin, Turchetti & Yurkov, gen. nov. & sp. nov.

Basidiomycota, Agaricomycotina, Tremellomycetes, Cystofilobasidiales, Mrakiaceae



1 **Rare and undersampled dimorphic basidiomycetes** **In press**

2

3 Kachalkin, A.V. †; Turchetti, B. †; Inácio, J. †; Carvalho, C.; Mašínová, T.; Pontes, A.; Röhl,
4 O.; Glushakova A.M.; Akulov, A.; Baldrian, P.; Begerow, D.; Buzzini, P.; Sampaio, J.P.;
5 Yurkov A.M.*

Mycological Progress

Rare and undersampled dimorphic basidiomycetes

--Manuscript Draft--

Vustinia terrae

Type strain KBP Y-5245 =DSM 105056

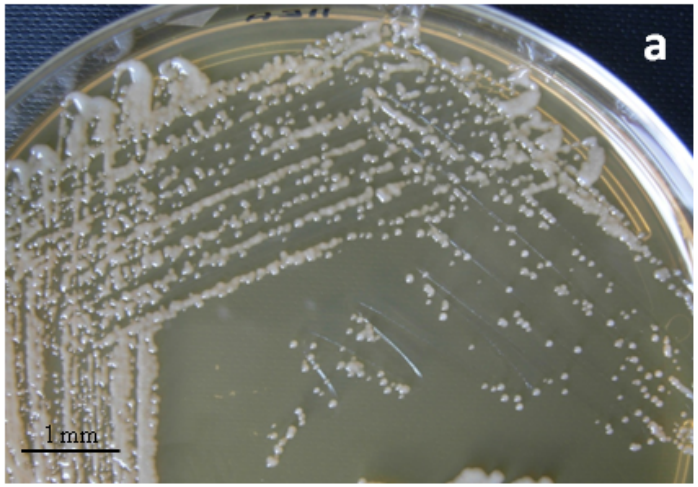
DSM 105056 strain on PDA after 7 d at 20 °C, vegetative cells. Scale bar: 10 µm. On PDA, streak is orange, glistening, butyrous and smooth, and have an entire margin.

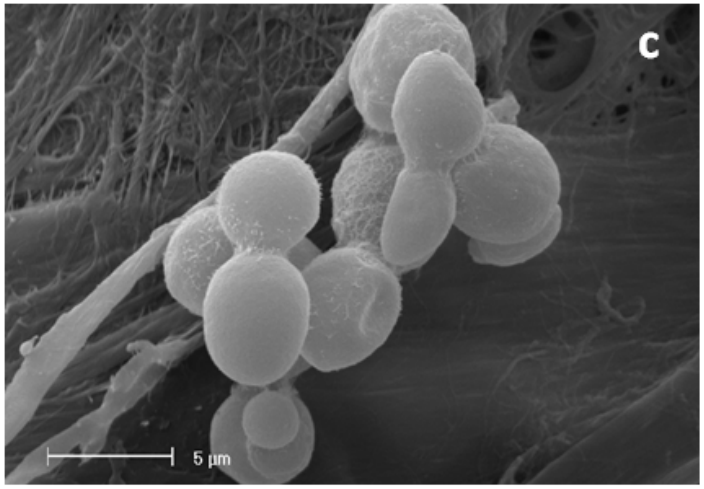
Maximum growth temperature **25°C,** optimum **20°C**.

Origin of the strains: **Republic of Altay, Russia**; Bishkek, Kyrgyzstan South Tyrol, **Alps** (**DBVPG 10597**)

NAGANISHIA VAUGHANMARTINIAE Turchetti, Blanchette et al sp. nov

Basidiomycota; Agaricomycotina; Tremellomycetes; Filobasidiales; Filobasidiaceae





Naganishia vaughanmartiniae
Type strain: **DBVPG 4736**
Orgin of the strains:
Antarctica, Alps
YEP broth: cells globose to subglobose, with extracellular starch-like polysaccharides and polar budding occurring in parent-bud pairs and in short chains of 3 cells
Budding: polar
Colonies in YEP Agar: colonies circular, smooth, glistening, flat, with entire margins, white coloured.
Teliospore: not present
Growth temperature: **4-25°C**

Extremophiles (2015) 19:149–159
DOI 10.1007/s00792-014-0692-3

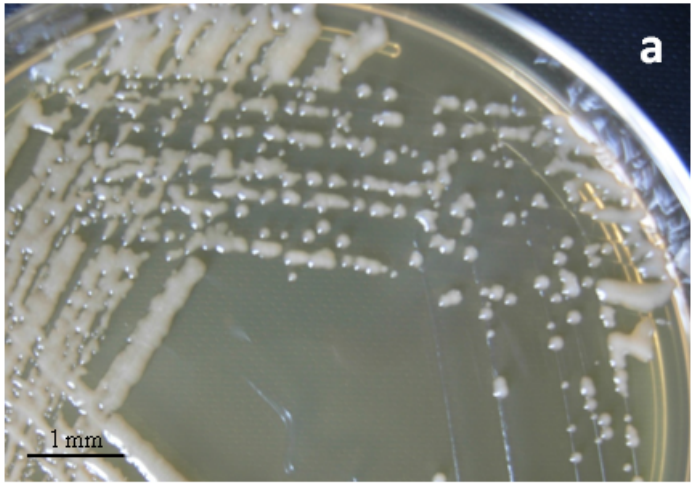
ORIGINAL PAPER

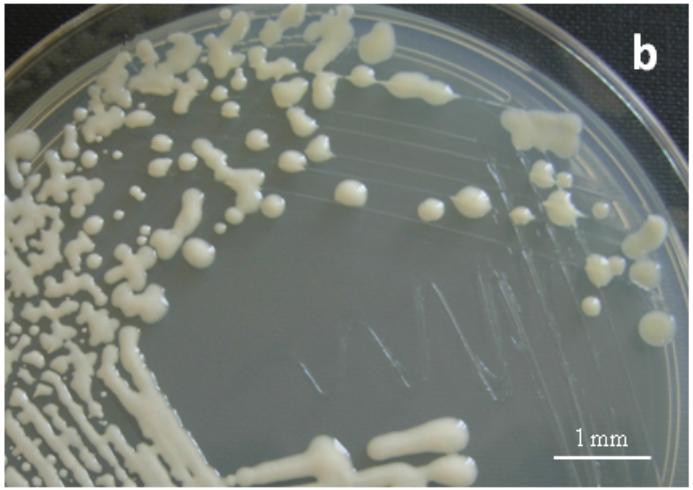
***Cryptococcus vaughanmartiniae* sp. nov. and *Cryptococcus onofrii* sp. nov.: two new species isolated from worldwide cold environments**

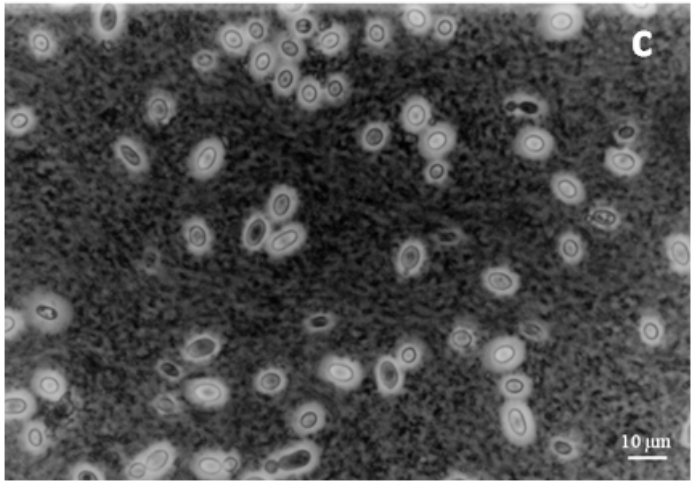
Benedetta Turchetti · Laura Selbmann · Robert A. Blanchette · Simone Di Mauro · Elisabetta Marchegiani · Laura Zucconi · Brett E. Arenz · Pietro Buzzini

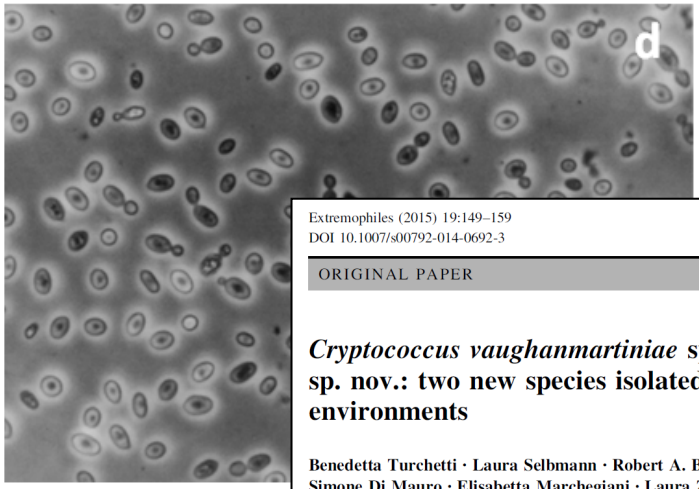
NAGANISHIA ONOFRII Turchetti, Selbmann & Zucconi sp. nov.

Basidiomycota; Agaricomycotina; Tremellomycetes; Filobasidiales; Filobasidiaceae









Naganishia onofrii
Type strain: **DBVPG 5303**
Orgin of the strains:
Antarctica
YEP broth: cells are mainly ellipsoidal - Cells on MEA after 10 days incubation at 25 C, after ink coloration, abundant capsules are visible
Budding: polar
Colonies on MEA: circular, smooth, glistering, flat, with entire margins, white coloured, with very mucoid texture close to being liquid.
Teliospore: not present
Growth temperature: **4-25°C**

Extremophiles (2015) 19:149–159
DOI 10.1007/s00792-014-0692-3

ORIGINAL PAPER

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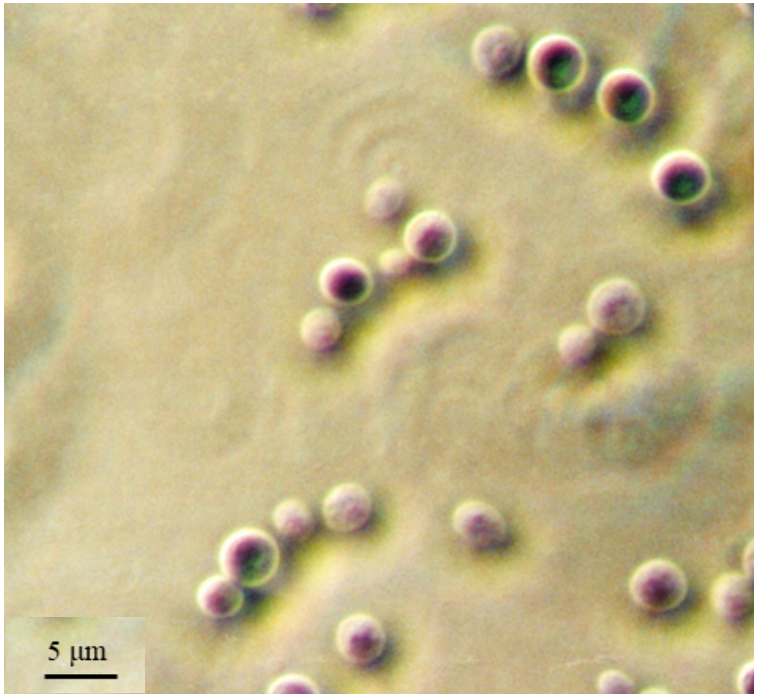
Benedetta Turchetti · Laura Selbmann · Robert A. Blanchette · Simone Di Mauro · Elisabetta Marchegiani · Laura Zucconi · Brett E. Arenz · Pietro Buzzini

NAGANISHIA NIVALIS Turchetti & Buzzini sp. nov

Basidiomycota; Agaricomycotina; Tremellomycetes; Filobasidiales; Filobasidiaceae



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5 Yurkov A.M.*

Mycological Progress

Rare and undersampled dimorphic basidiomycetes

--Manuscript Draft--

Naganishia nivalis

Type strain: **DBVPG 5693**

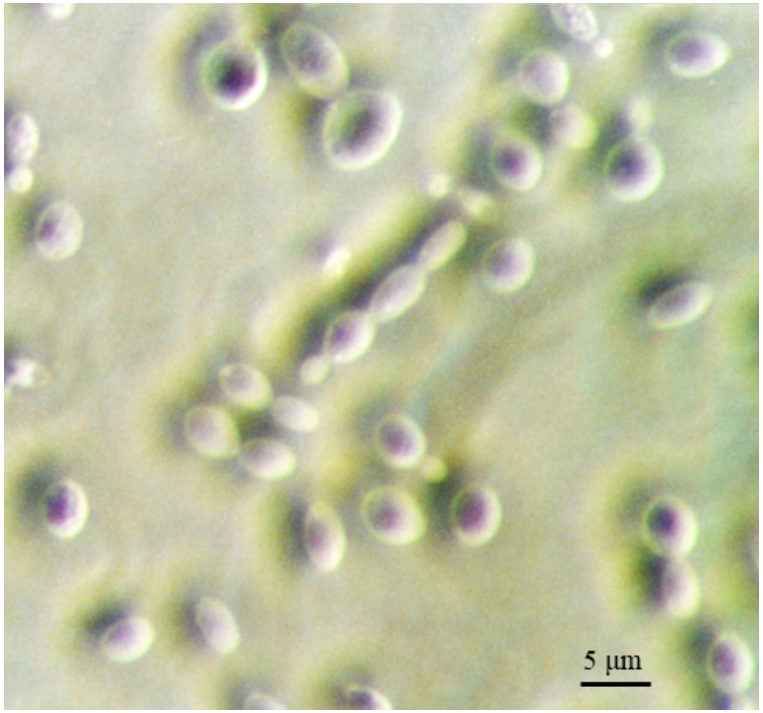
DBVPG 5693 strain GPY agar, after 7 d at 25 °C, vegetative cells. On GPY agar, MEA, and PDA, after 7 d at 25 °C, streak is white to cream, surface is dull and wrinkled in some colonies with surface striation similar to radial valley; margins are smooth and entire and the profile is smooth and raised; the texture is viscous to butyrous.

Optimum growth temperature **25°C,** no growth was shown at 37 °C

Origin of the strains: Mont Blanc massif, **Alps**

HETEROCEPHALACRIA GELIDA Turchetti & Kachalkin sp. nov.

Basidiomycota; Agaricomycotina; Tremellomycetes; Filobasidiales; Filobasidiaceae



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Mycological Progress

Rare and undersampled dimorphic basidiomycetes

--Manuscript Draft--

Heterocephalacria gelida

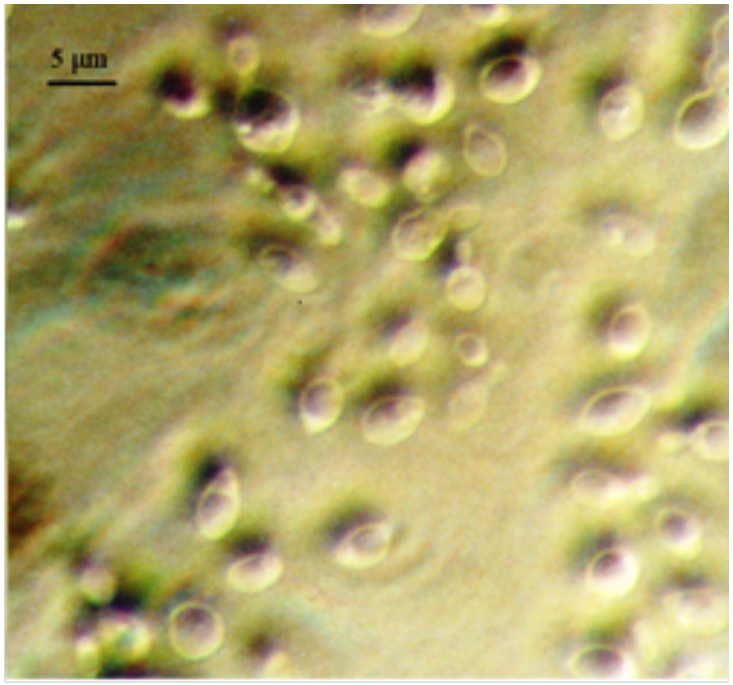
Type strain **DBVPG 5868**

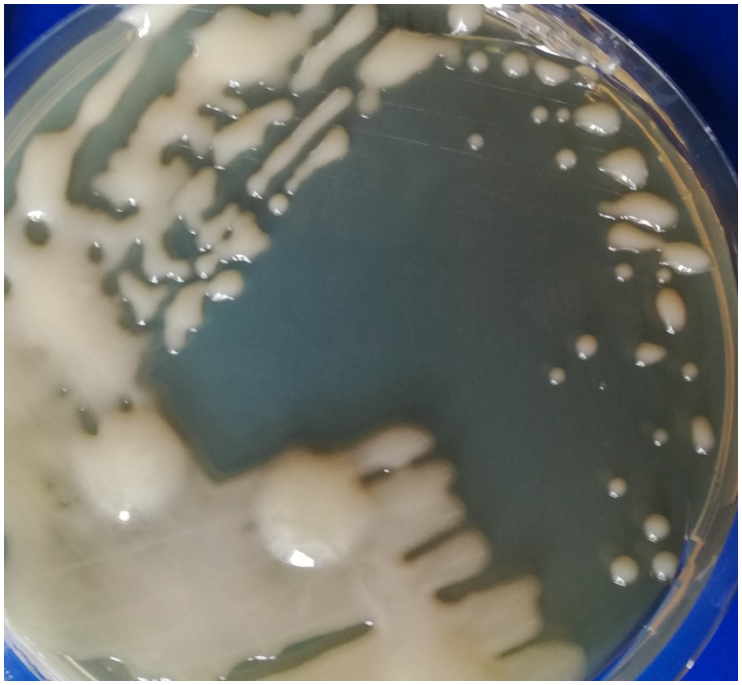
DBVPG 5868 strain on GPY agar, after 7 d at 25 °C, vegetative cells. On GPY agar and PDA, streak culture is whitish to cream-colored, mucoid and viscous with a glistering smooth surface. Margins are smooth and entire, and the profile is flat. Optimum growth temperature **25°C**

Origin of the strains: Mont Blanc massif-**Alps**, Krasnoyarsk Krai, Russia.

PISKUROZYMA SILVICULTRIX Turchetti, Mašínová, Baldrian &Yurkov sp. nov.

Basidiomycota; Agaricomycotina; Tremellomycetes; Filobasidiales; Piskurozymaceae





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5 Yurkov A.M.*

Mycological Progress

Rare and undersampled dimorphic basidiomycetes

--Manuscript Draft--

Piskurozyma silvicultrix

Type strain: **DBVPG 10557**

DBVPG 10557 strain GPY agar, after 7 d at 25 °C, vegetative cells. On GPY agar, MEA and PDA, after 7 d at 25 °C, streak is white to creamy/yellowish, with glistering smooth surface without striation, margins are smooth and entire and the profile is flat; the texture is mucoid to fluid Optimum growth temperature **25°C**

Origin of the strains: **Alps**, South Tyrol and Czech Republic (DSM 103194 and DSM 103201)

DIOSZEGIA PATAGONICA Trochine, Turchetti , et al. sp. nov.

Basidiomycota; Agaricomycotina; Tremellomycetes; Tremellales; Bulleribasidiaceae

Dioszegia patagonica

Phase-contrast micrograph of strain CRUB 1147T on YM agar after 3 days at 20 °C. Budding cells are visible. Bar, 10 μm.

CRUB 1147T (UFMG 195T=CBMAI 1564T=**DBVPG 10618T**=CBS 14901)

Temperature range for growth was **4–25°** C, with optimum at 20°C.

Isolated from **Italian Alps** and from **Parque Nacional Nahuel Huapi , Argentina**

INTERNATIONAL JOURNAL OF SYSTEMATIC AND EVOLUTIONARY MICROBIOLOGY

TAXONOMIC DESCRIPTION

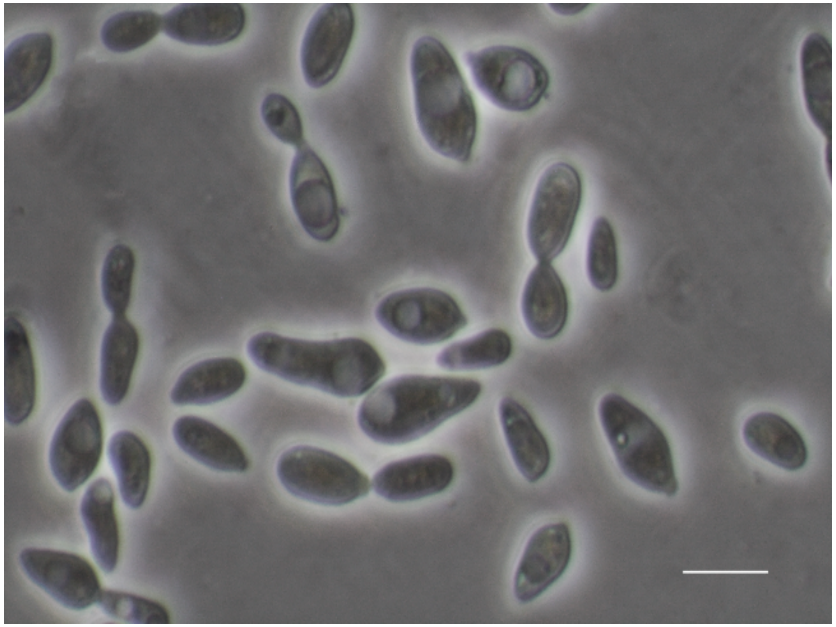
Trochine *et al.*, *Int J Syst Evol Microbiol* 2017;67:4332–4339

DOI 10.1099/ijsem.0.002211

MICROBIOLOGY SOCIETY

Description of *Dioszegia patagonica* sp. nov., a novel carotenogenic yeast isolated from cold environments

Andrea Trochine,[1] Benedetta Turchetti,[2] Aline B. M. Vaz,[3] Luciana Brandao,[3] Luiz H. Rosa,[3] Pietro Buzzini,[2] Carlos Rosa[3] and Diego Libkind[1,*]



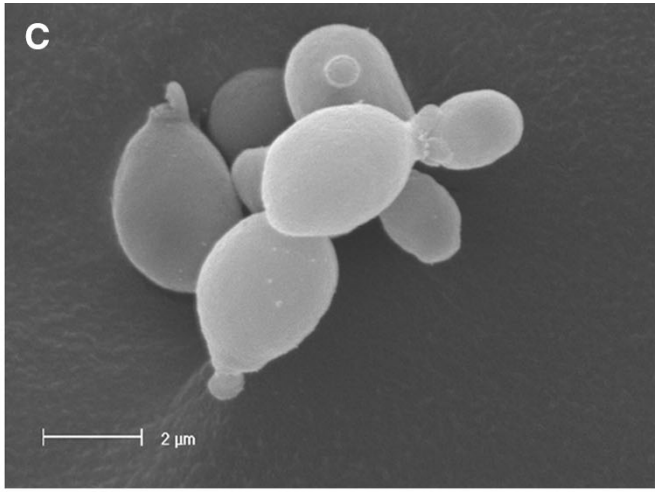
TAPHRINA ANTARCTICA Selbmann and Turchetti sp. nov.

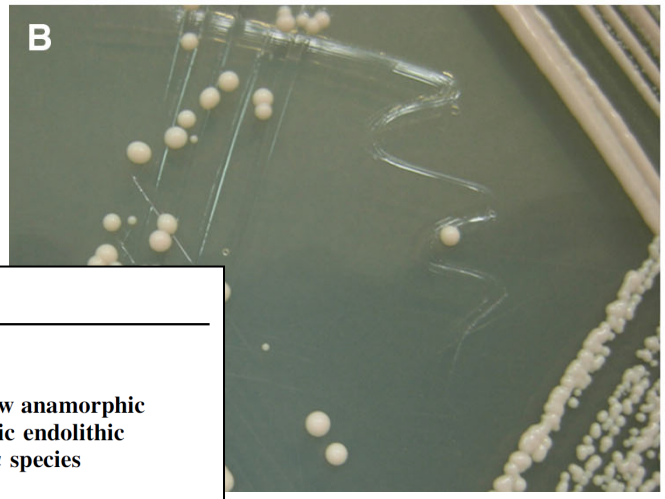
Ascomycota; Taphrinomycotina; Taphrinomycetes; Taphrinales; Taphrinaceae

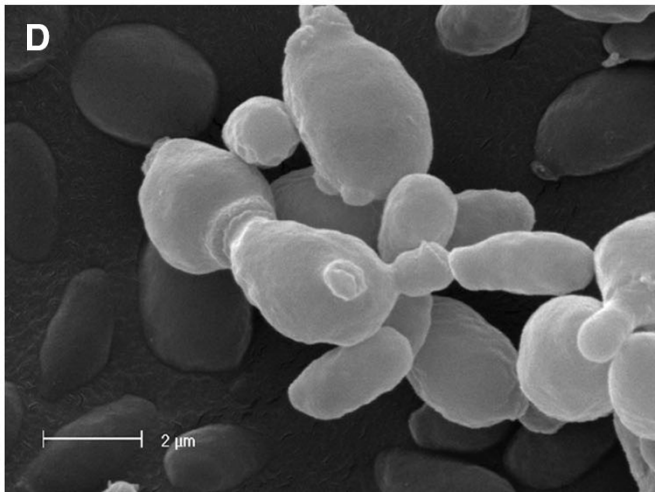
Taphrina antarctica
Type strain CCFEE 5198 = **DBVPG 5268** = DSM 27485 = CBS 13532.
(a) Colonies grown on PDA and MEA (b) after 6 weeks incubation at 10°C.
(c) and (d) Scanning electron micrograph (SEM) of the strain cultured on MEA after 3 weeks incubation at 10°C
Orgin of the strains:

Antarctica

Temperature range for growth was **4–20° C**, with optimum at 10°C.







Extremophiles (2014) 18:707–721
DOI 10.1007/s00792-014-0651-z

ORIGINAL PAPER

Description of *Taphrina antarctica f.a.* sp. nov., a new anamorphic ascomycetous yeast species associated with Antarctic endolithic microbial communities and transfer of four *Lalaria* species in the genus *Taphrina*

Laura Selbmann · Benedetta Turchetti · Andrey Yurkov · Clarissa Cecchini · Laura Zucconi · Daniela Isola · Pietro Buzzini · Silvano Onofri

DBVPG New Exploitations

Hard environmental conditions
temperatures, Aw, low organic nutrients availability,
high hydrostatic pressure, high solar radiation

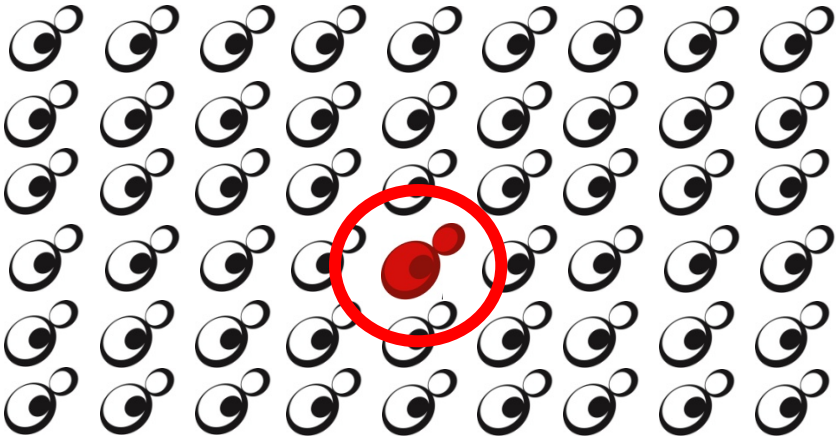
Adaptation strategies:

- ✓ Change of the chemical composition of cellular membrane
- ✓ Synthesis of protecting proteins and cryoprotective macromolecules
- ✓ Reduction of growth rates
- ✓ Synthesis of cold-active enzymes
- ✓ Intracellular lipids accumulation

Non Conventional Yeasts - NCYs

Taxonomy - Basic research

Applied research – Primary and secondary screening



DBVPG New Exploitations – Cold Active Enzymes

Strains CRUB	Lipase activity in cell-free supernatant (mU/mg protein) Temperature (°C)					Species
	4	10	15	20	25	
138	8.4 ^{c}	7.8 ^{c}	5.7 ^{b}	3.7 ^{a}	4.0 ^{a}	*Rhodotorula mucilaginosa*
1122	7.6 ^{d}	4.9 ^{c}	3.9 ^{b}	1.9 ^{a}	1.8 ^{a}	*Rhodotorula* spp.
1290	6.7 ^{d}	5.1 ^{c}	3.5 ^{b}	1.2 ^{a}	0	*Cryptococcus macerans*
1141	6.4 ^{c}	5.9 ^{c}	2.8 ^{b}	1.1 ^{a}	0.8 ^{a}	*Sporobolomyces ruberrimus*
1176	6.0 ^{c}	6.2 ^{c}	4.0 ^{b}	3.1 ^{a}	1.4 ^{a}	*Rhodotorula colostri*
1267	5.4 ^{d}	3.9 ^{c}	3.6 ^{c}	2.2 ^{b}	0.8 ^{a}	*Cryptococcus laurentii*
1221	4.2 ^{c}	3.7 ^{c}	1.8 ^{b}	0.8 ^{a}	0.9 ^{a}	*Cryptococcus* spp.
195	4.2 ^{b}	3.5 ^{b}	1.0 ^{a}	0.8 ^{a}	0	*Rhodotorula mucilaginosa*
1274	3.9 ^{c}	1.8 ^{b}	0.6 ^{a}	0	0	*Dioszegia crocea*
1152	3.8 ^{c}	3.9 ^{c}	2.2 ^{b}	1.0 ^{a}	1.1 ^{a}	*Dioszegia* sp. 1
1265	3.2 ^{c}	1.3 ^{b}	0.6 ^{a}	0	0	*Cryptococcus laurentii*
Mean values	5.43^{4}	4.36^{3}	2.70^{2}	1.43^{1}	0.98^{1}	

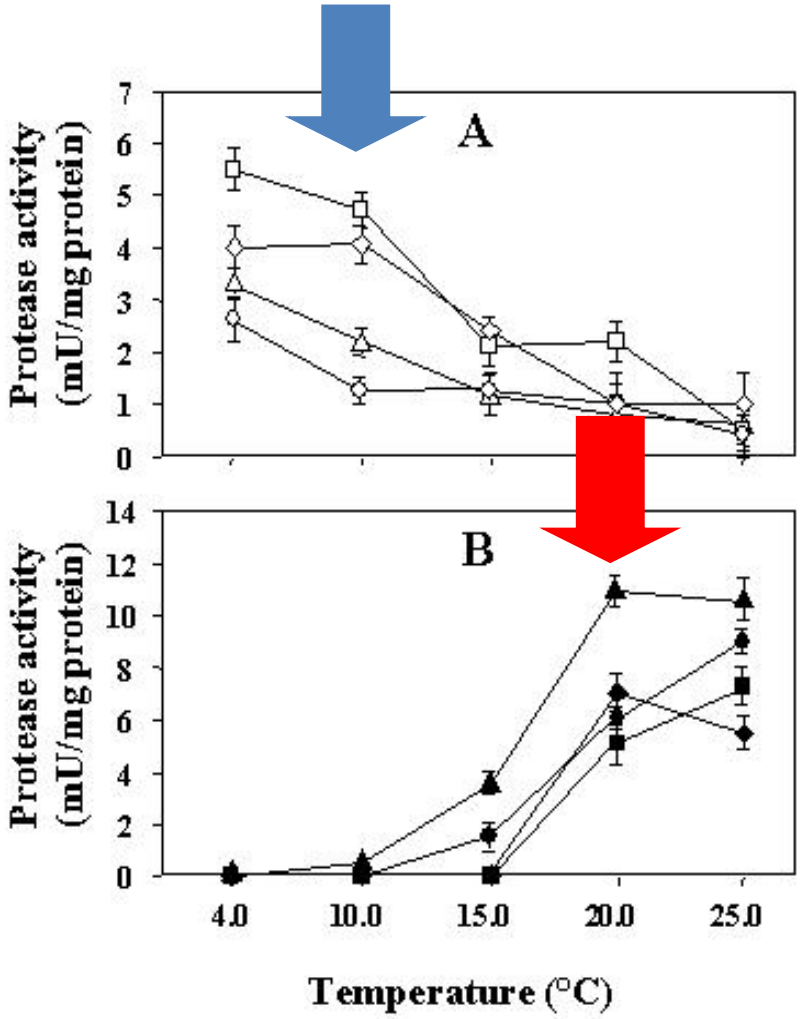
Extracellular enzymatic activity at different temperatures of psychrophilic yeast cell-free extracts

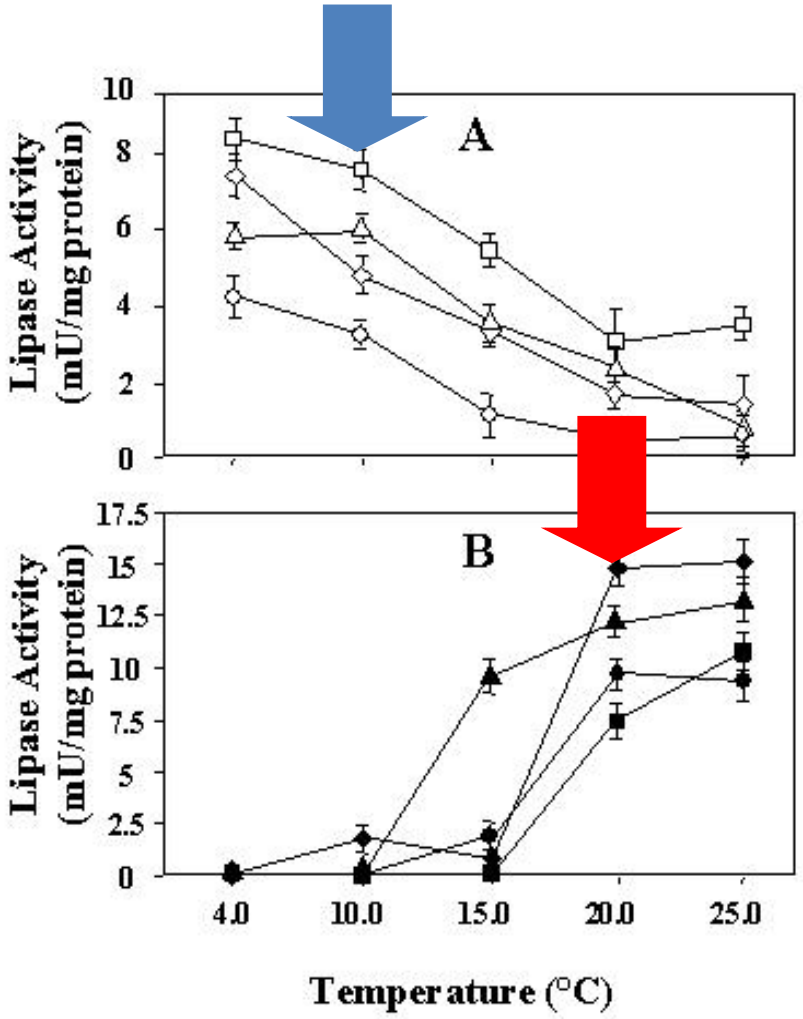
Strains CRUB	Protease activity in cell-free supernatant (mU/mg protein) Temperature (°C)					Species
	4	10	15	20	25	
1211	5.5. ^{c}	4.8 ^{c}	2.5 ^{b}	2.6 ^{b}	0.8 ^{a}	*Leucosporidiella fragaria*
1236	4.8 ^{b}	4.2 ^{b}	3.7 ^{ab}	3.1 ^{a}	2.8 ^{a}	*Cryptococcus* spp.
1178	4.1 ^{c}	4.2 ^{c}	2.8 ^{b}	1.3 ^{a}	1.2 ^{a}	*Cryptococcus macerans*
1214	3.8 ^{c}	4.4 ^{c}	2.1 ^{b}	0.6 ^{a}	0	*Leucosporidiella creatinivora*
1204	3.6 ^{c}	1.5 ^{b}	1.3 ^{b}	0.9 ^{ab}	0.4 ^{a}	*Leucosporidiella fragaria*
1200	3.4 ^{c}	2.3 ^{b}	1.4 ^{a}	1.0 ^{a}	1.2 ^{a}	*Leucosporidiella fragaria*
1202	3.3 ^{d}	2.1 ^{c}	1.1 ^{b}	0.8 ^{ab}	0.2 ^{a}	*Leucosporidiella fragaria*
1210	3.0 ^{c}	2.4 ^{c}	1.4 ^{b}	0.7 ^{a}	1.1 ^{ab}	*Leucosporidiella fragaria*
1046	2.7 ^{c}	1.3 ^{b}	1.5 ^{b}	1.4 ^{b}	0.5 ^{a}	*Cystofilobasidium* sp. 1
Mean values	3.42^{3}	2.72^{2,3}	1.93^{1,2}	1.44^{1}	1.07^{1}	

DBVPG New Exploitations – Cold Active Enzymes

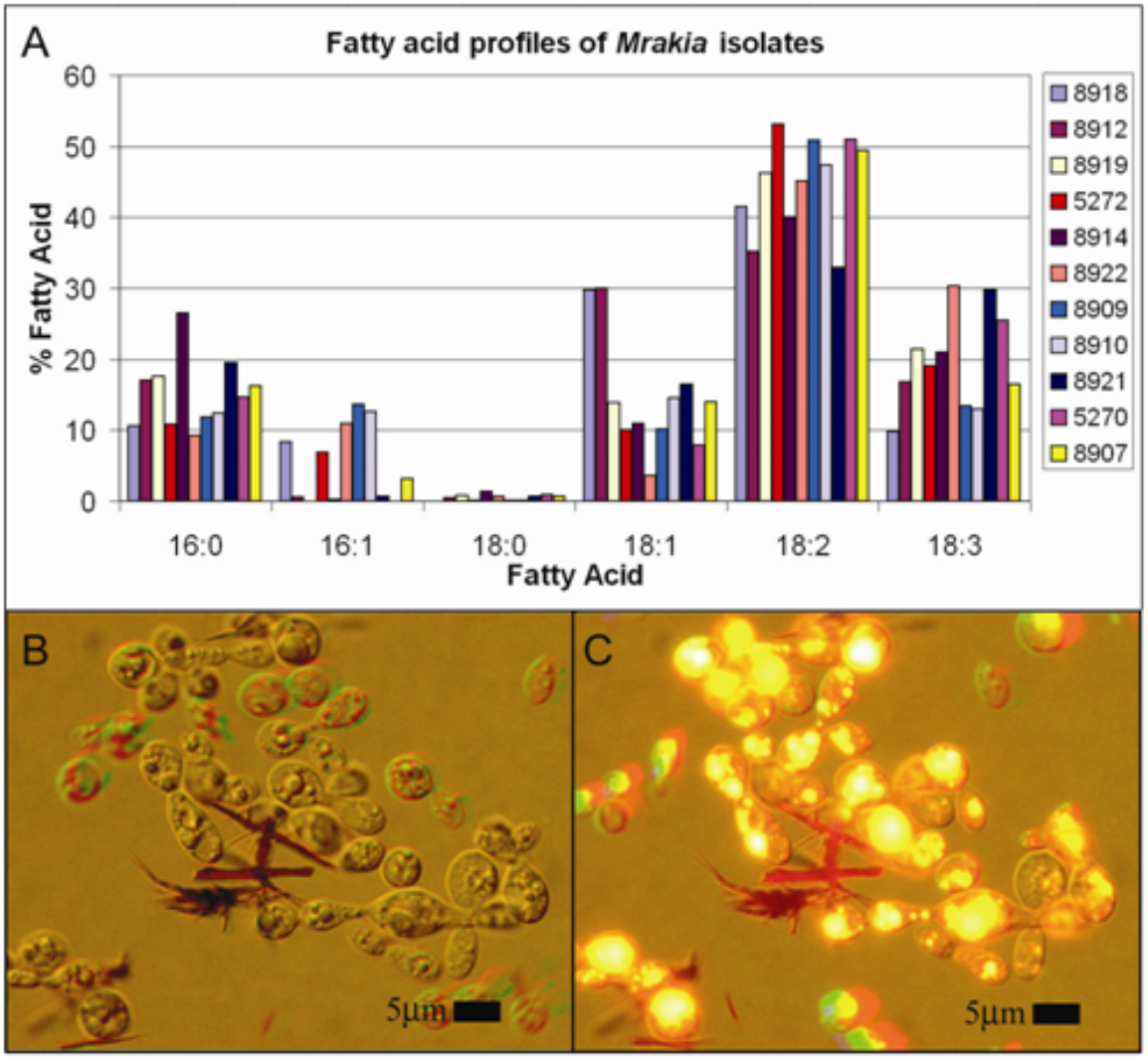
Yeasts isolated from glaciers

Yeasts isolated from tropical habitat



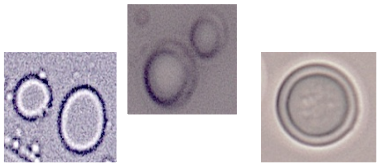


DBVPG New Exploitations – Lipids production



LARGE SCALE SCREENING

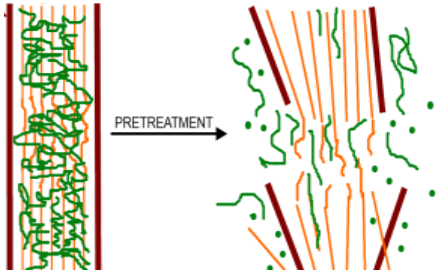
770 DBVPG yeast strains → C3, C5, C6, C12 → A few seleted strains



LIPIDS FROM LIGNOCELLULOSIC BIOMASS

Lignocellulosic Biomass

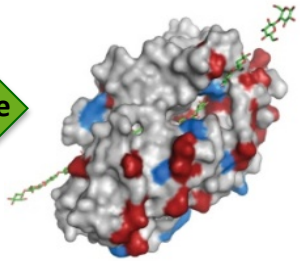
Steam exploded biomass



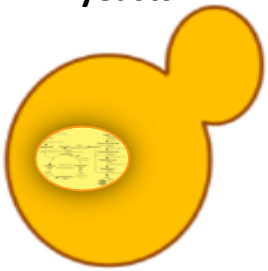
Hydrolysate biomass

C6 (C5)

Solid phase



Selected oleaginous yeasts



Triacylglycerols

Biochemicals

Bio-chemical for cosmetics

Bio-plastic

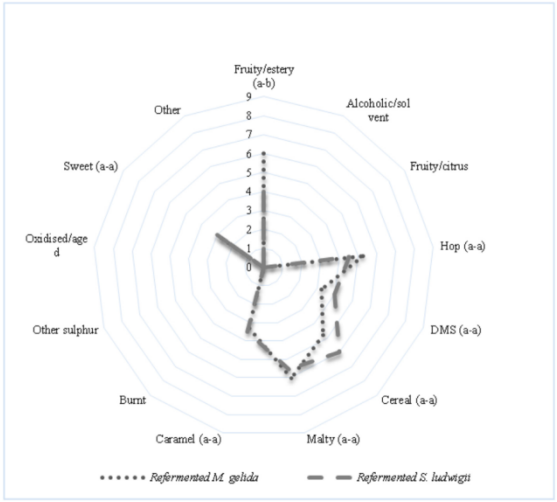
Bio-lubricants

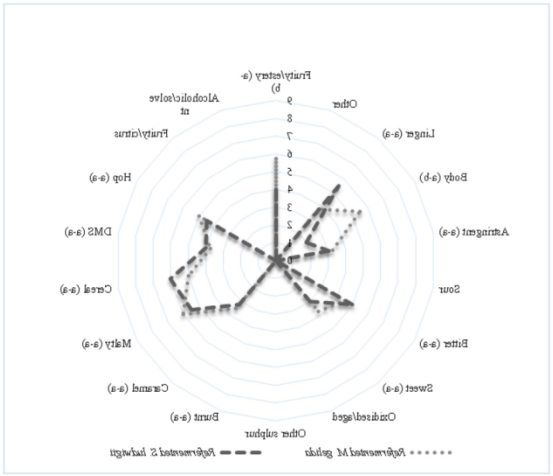
Platform chemicals

Bio-diesel

DBVPG New Exploitations – Beer production

Mrakia gelida in brewing process: An innovative production of low alcohol beer using a psychrophilic yeast strain (DBVPG 5952)





Low alcohol content (1.40%) and low diacetyl production (5.04 µg/L)

The organoleptic characteristics of the beer obtained using M. gelida are more appreciated by the panelist than the one procude with the commercial starter *Saccharomycodes ludwigii* WSL17

Visual aspect : clear, yellow in colour with a fine head and a persistent foam.
Aroma profile resulted better than the correspondent *S. ludwigii* beer, especially for the olfactive intensity of the fruity descriptor

Importance of the Collections

BIODIVERSITY

strains from many different habitats and years

(some unique)

+

LARGE NUMBERS

of strains conserved

give statistic advantage in finding the

 **SUPER STRAIN/S** 

non-conventional yeasts (NCYs)

WHY DON'T LOOK INSIDE OUR COLLECTIONS?

THANK YOU FOR YOUR ATTENTION

Pietro Buzzini
Ciro Sannino
Ambra Mezzasoma
Giorgia Tasselli

- Italian Glaciological Society
- Everest-K2-CNR Committee

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