



Description of Yeast Strains Frisinga - TUM 34/70[®] and Proles - TUM 34/78[®] *Saccharomyces pastorianus ssp. carlsbergensis*, bottom-fermenting, flocculent yeast

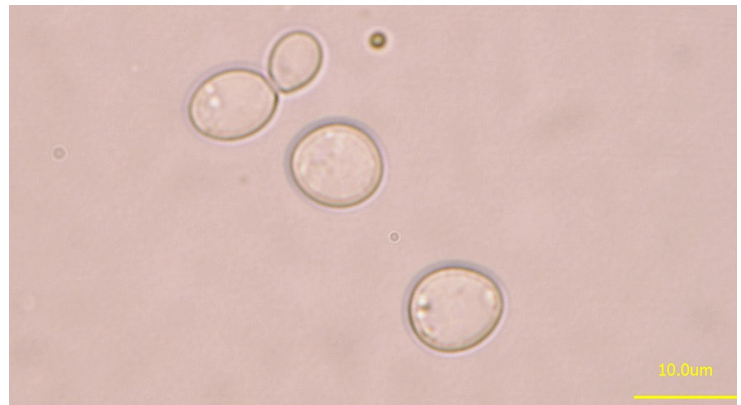
These yeast strains are excellently suited for the production of bottom-fermented beers of all types. The resulting beer possesses an extremely pure flavor, a fine, subtle aroma and a mild overall impression. Fermentation is rapid with optimal yeast flocculation. The degree to which the color lightens during fermentation is sufficient.

The principle difference between Frisinga - TUM 34/70[®] and Proles - TUM 34/78[®] is their flocculation behavior during primary fermentation. The Proles - TUM 34/78[®] strain can remain somewhat longer in suspension. The length of time that the yeast remains in suspension is dependent on conditions present in the brewery.

The following beer analyses were performed after 6 days of primary fermentation (original gravity: 11.6 %).

Beer Analysis

Apparent degree of attenuation (%)	73
Cells in suspension (millions/ml)	12.5
pH value	4.6
Difference between final and apparent degree of attenuation (%)	0
Diacetyl (mg/l) in green beer	0.7
Diacetyl (mg/l) in matured beer	0.1
Acetaldehyde (mg/l)	6
Higher (aliphatic) alcohols (mg/l)	58
Esters (mg/l)	18.5
Foam, Ross & Clark method (sec)	132



Yeast strain TUM 34/70 viewed through a microscope
(Image TUM 34/70 © FZW BLQ)

Strains Frisinga - TUM 34/70[®] and Proles - TUM 34/78[®]: Overview of Attributes

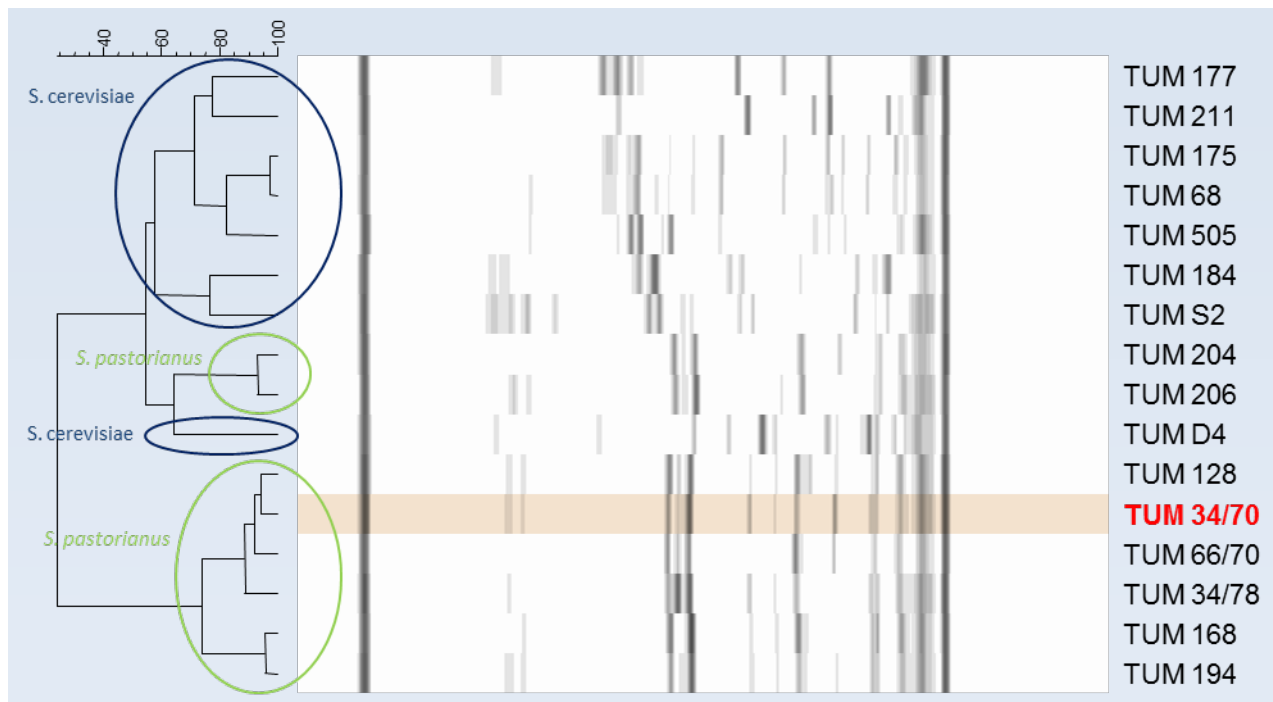
Fermentation rate	high
pH reduction	normal
Flocculation	optimal
Diacetyl reduction	very good
Foam	very good
Difference between final and apparent degree of attenuation	very low
Acetaldehyde	normal
Higher alcohols	very low
Esters	Pronounced

Real-time PCR Screening Profile:

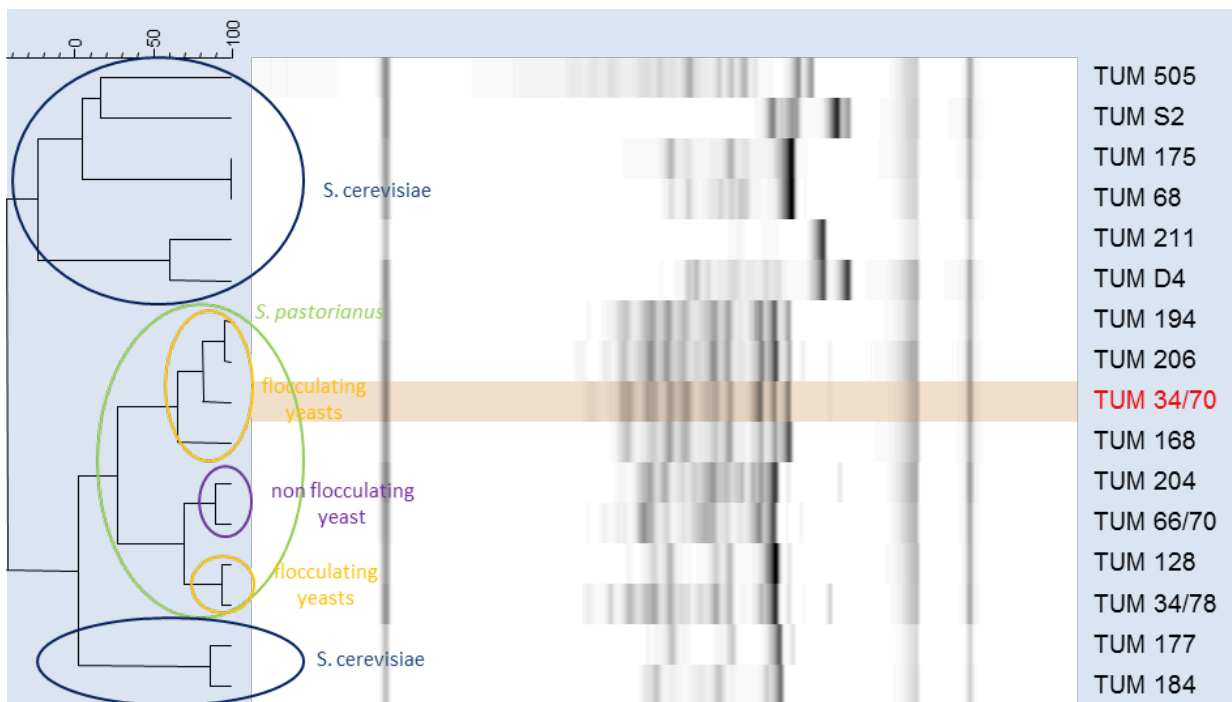
Comparison of individual qualitative results from real-time PCR systems for the differentiation of industrial *Saccharomyces* strains (with a focus on *S. cerevisiae* and *S. pastorianus* (bottom-fermenting strains)) (according to Hutzler, M. 2009, Hutzler, M. 2010)

Yeast	Strain	PCR System					
		Sc-GRC3	Sce	OG-COXII	Sbp	UG-LRE 1	UG-300
<i>S. bayanus</i>	DSM 70412T, 70547, BTII K 1-C-3	-	-	-	+	-	-
	70411, 70508	-	-	-	+	+	+
<i>S. bayanus/pastorianus</i>	CBS 2440, 6017	-	-	-	+	+	+
<i>S. pastorianus</i>	CBS 1503, 1513, 1538, DSM 6580NT, 6581	-	-	-	+	+	+
<i>S. pastorianus</i> (bottom-fermenting)	TUM 26, 44, 34/70, 34/78, 44, 54, 59, 69, 84, 105, 109, 120, 128, 168, 172, 180, 194, 199, 206 (flocculent yeasts)	+	+	-	+	+	+
	TUM 71, 144 (low or non-flocculent yeasts)						
	CBS 1484, 5832, CBS 6903, NBRC 2003, BTII K B-I-4, B-J-4, B-J-5						
	TUM 120 (flocculent yeast) TUM 66, 66/70, 204 (low or non-flocculent yeasts) CBS 5832, CBS 6903	+	+	-	+/-	+	+
<i>S. cerevisiae</i>	DSM 70424, 70449T, 70451, CBS 1464, 8803, BT II K 3-A-1, 3-C-3, 3-G-1, 5-A-7, 6-I-1, 6-F-4	+	+	+	-	-	-
<i>S. cerevisiae</i> (top-fermenting)	TUM 68, 127, 149, 175, 205, BTII K 5-A-8 (Southern German style wheat beer yeast)	+	+	+	-	-	-
	TUM 148, 184, 208 (alt yeast)	+	+	+	-	-	-
	TUM 165, 177 (kölsch yeast)	+	+	+	-	-	-
	TUM 210, 211, 213 (ale yeast)	+	+	+	-	-	-
	TUM Bingen, Bordeaux, Eperney, Laureiro, Stein, Wädensvill (wine yeast)	+	+	+	-	-	-
	TUM B4 (distillers' yeast)	+	+	+	-	-	-
	TUM S2 (sparkling wine yeast)	+	+	+	-	-	-
<i>S. cerevisiae var. diastaticus</i>	CBS 1782, DSM 70487, BTII K 1-B-8, 1-H-7, 2-A-7, K 2-F-1, 3-D-2, 3-H-2, 3-H-4	+	+	+	-	-	-
<i>S. cariocanus</i>	CBS 7995, 8841	-	+	-	-	-	-
	CBS 5313	+	+	+	-	-	-
<i>S. kudriavzevii</i>	CBS 8840	-	-	-	-	-	-
<i>S. mikatae</i>	CBS 8839	-	-	-	-	-	-
<i>S. paradoxus</i>	CBS 406, 432, 2908, 5829, 7400, 8436	-	+	-	-	-	-

Genetic fingerprint profile:



The virtual electrophoresis gel depicted above was created using capillary electrophoresis separated by interdelta PCR ($\delta 12/\delta 21$). Pictured are results for strain TUM 34/70 compared with a selection of yeast strains most frequently supplied by the Weihenstephan Research Center (FZW BLQ).



A virtual image of the rDNA IGS2_314 genetic fingerprint of yeast strains separated using capillary gel electrophoresis is depicted above. Pictured are the results for strain Frisinga - TUM 34/70® compared with a selection of yeast strains most frequently supplied by the Weihenstephan Research Center (FZW BLQ)

Sources:	Hutzler M.:	Dissertation : "Entwicklung und Optimierung von Methoden zur Identifizierung und Differenzierung von getränkerelevanten Hefen" (2009)
	Hutzler M.:	Book: "Getränkerelevante Hefen- Identifizierung und Differenzierung: Wie können Hefen praxisrelevant unterschieden werden, und wie können Identifizierungsergebnisse technologisch bewertet werden?" (2010) ISBN 978-3-8381-1482-8
	Stretz D.; Hutzler M.; et al.:	Brauwelt: "Qualitätssicherung beginnt bei der Hefeanzucht – Hefe in Reinstform" (2010)
	Riedl R.; et al.:	EBC Congress Glasgow: „Yeast Strain Identification by a Combination of Partial IGS2-rDNA-PCR and Rep-PCR Fingerprinting" (2011)
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	Geiger E.; Tenge C.:	Lecture "Technologie der Gärung" (Stand WS 2007/2008)
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