

SUPPLEMENTARY MATERIAL

Assessment of the effect of nitrogen concentration on fermentation and selection of a highly competitive *Saccharomyces cerevisiae* strain for efficient ethanol production

Patricia Portero Barahona^{1,2}, Jesús Martín-Gil², Pablo Martín-Ramos³, Ana Briones⁴ and Enrique Javier Carvajal Barriga¹

- ¹ Colección de Levaduras Quito Católica (CLQCA), Centro Neotropical para Investigación de la Biomasa, Pontificia Universidad Católica del Ecuador, Avda. 12 de Octubre 1076 y Roca, 17012184, Quito, Ecuador
- ² Agriculture and Forestry Engineering Department, ETSIIAA, Universidad de Valladolid, Avda. de Madrid 44, 34004 Palencia, Spain
- ³ Department of Agricultural and Environmental Sciences, EPS, Instituto de Investigación en Ciencias Ambientales (IUCA), University of Zaragoza, Carretera de Cuarte, s/n, 22071 Huesca, Spain
- ⁴ Analytical Chemistry and Food Technology Department, Universidad de Castilla-La Mancha, Avda. Camilo José Cela, 10, 13071 Ciudad Real, Spain

Table S1. Yeast strain screening results.

Code	Substrate	Assimilation									Fermentation									Ethano l (g/L)	Ethanol yield (g ethanol·g glucose ⁻¹)	Theoretical ethanol yield (%)
		Gl u	Xy l	Ma l	Ga l	La c	Su c	Ra f	Ce l	Gl u	Xy l	Ma l	Ga l	La c	Su c	Ra f	Ce l					
CLQCA-02-003	Vegetal material	+	-	+	+	-	+	+	W	+	-	+	+	-	+	+	-	39.07	0.39	76.45		
CLQCA-04-021	Insect	+	-	-	+	-	+	+	-	W	-	-	+	-	+	L	-	40.12	0.40	78.51		
CLQCA-04-048	Vegetal material	+	-	+	+	-	-	-	-	+	-	+	+	-	-	-	-	42.44	0.42	83.05		
CLQCA-05-006	Vegetal material in decomposition	+	-	+	+	-	+	+	-	+	-	W	+	-	+	+	-	37.09	0.37	72.58		
CLQCA-09-001	Vegetal material	+	-	S	+	-	+	+	-	+	-	-	+	-	+	+	-	43.37	0.43	84.87		
CLQCA-09-002	Fermented beverages	+	-	+	+	-	+	+	-	S	-	+	S	-	+	W	-	41.22	0.41	80.66		
CLQCA-09-003	Fermented beverages	+	-	+	+	-	+	+	-	S	-	S	+	-	S	S	-	43.11	0.43	84.36		
CLQCA-09-004	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	44.67	0.45	87.41		
CLQCA-09-005	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	S	-	42.38	0.42	82.93		
CLQCA-09-006	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	L	-	+	+	-	44.49	0.44	87.06		

CLQCA-09-008	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	L	-	+	+	-	41.33	0.41	80.88
CLQCA-09-009	Fermented beverages	+	-	+	+	-	+	+	-	+	-	L	+	-	+	+	-	42.54	0.42	83.25
CLQCA-09-011	Fermented beverages	+	-	+	+	-	+	+	-	S	-	S	+	-	L	W	-	42.38	0.42	82.93
CLQCA-09-012	Fermented beverages	+	-	+	+	-	+	+	-	L	-	+	+	-	+	+	-	43.28	0.43	84.69
CLQCA-09-015	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	41.73	0.42	81.66
CLQCA-09-016	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	44.14	0.44	86.38
CLQCA-09-017	Fermented beverages	+	-	+	+	-	+	+	-	+	-	S	+	-	+	+	-	43.01	0.43	84.17
CLQCA-09-018	Fermented beverages	+	-	+	+	-	+	+	-	W	-	W	W	-	+	+	-	42.02	0.42	82.23
CLQCA-09-019	Fermented beverages	+	-	+	+	-	+	+	-	L	-	L	S	-	+	+	-	43.13	0.43	84.40
CLQCA-09-021	Fermented beverages	+	-	+	+	-	+	+	-	S	-	+	S	-	L	S	-	43.21	0.43	84.56
CLQCA-09-022	Fermented beverages	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	41.42	0.41	81.05
CLQCA-09-024	Fermented beverages	+	-	+	+	-	+	+	-	+	-	S	+	-	+	S	-	40.08	0.40	78.43
CLQCA-09-025	Fermented beverages	+	-	+	+	-	+	+	-	+	-	S	+	-	+	S	-	43.21	0.43	84.56
CLQCA-09-027	Fermented beverages	+	-	+	+	-	+	+	-	S	-	+	+	-	L	L	-	44.24	0.44	86.57
CLQCA-09-028	Fermented beverages	+	-	+	+	-	+	+	-	L	-	+	+	-	L	W	-	42.52	0.42	83.21
CLQCA-09-030	Fermented beverages	+	-	+	+	-	+	+	-	W	-	+	+	-	W	W	-	42.26	0.42	82.70
CLQCA-09-037	Fermented beverages	+	-	+	+	-	+	+	-	+	-	W	W	-	W	+	-	42.31	0.42	82.80
CLQCA-09-038	Fermented beverages	+	-	+	+	-	+	+	-	W	-	W	+	-	W	W	-	41.27	0.41	80.76
CLQCA-09-040	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	S	-	44.29	0.44	86.67
CLQCA-09-042	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	43.11	0.43	84.36
CLQCA-09-043	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	S	-	43.08	0.43	84.30
CLQCA-09-044	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	44.41	0.44	86.90
CLQCA-09-046	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	S	-	40.08	0.40	78.43
CLQCA-10-003	Insect	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	43.16	0.43	84.46
CLQCA-10-004	Insect	+	-	+	+	-	+	+	-	+	-	+	+	-	+	S	-	44.24	0.44	86.57
CLQCA-10-027	Vegetal material	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	43.21	0.43	84.56
CLQCA-10-082	Archaeological vessels	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	44.09	0.44	86.28
CLQCA-10-083	Archaeological vessels	+	-	+	+	-	+	+	-	+	-	L	L	-	+	+	-	43.25	0.43	84.63
CLQCA-10-084	Archaeological vessels	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	43.09	0.43	84.32
CLQCA-10-096	Archaeological vessels	+	-	+	+	-	+	+	-	+	-	+	+	-	+	-	-	44.01	0.44	86.12
CLQCA-10-097	Archaeological vessels	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	40.32	0.40	78.90
CLQCA-10-098	Archaeological vessels	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	42.25	0.42	82.68

CLQCA-10-099	Archaeological vessels	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	46.25	0.46	90.51
CLQCA-10-100	Archaeological vessels	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	39.28	0.39	76.87
CLQCA-10-101	Archaeological vessels	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	38.26	0.38	74.87
CLQCA-10-169	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	41.02	0.41	80.27
CLQCA-10-170	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	42.13	0.42	82.44
CLQCA-10-171	Fermented beverages	+	-	+	+	-	+	+	+	+	-	+	+	-	+	+	W	42.42	0.42	83.01
CLQCA-10-173	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	43.32	0.43	84.77
CLQCA-10-193	Fermented beverages	+	-	+	-	-	-	-	-	+	-	-	-	-	-	-	-	44.01	0.44	86.12
CLQCA-10-215	Vegetal material	+	-	+	+	-	+	+	W	+	-	+	+	-	+	S	-	40.32	0.40	78.90
CLQCA-10-234	Fermented beverages	+	-	+	+	-	+	+	W	+	-	+	+	-	+	S	-	42.52	0.42	83.21
CLQCA-10-235	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	S	+	-	43.01	0.43	84.17
CLQCA-10-255	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	S	-	43.26	0.43	84.65
CLQCA-10-319	Animal intestine	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	41.37	0.41	80.96
CLQCA-10-323	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	41.26	0.41	80.74
CLQCA-10-324	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	40.19	0.40	78.65
CLQCA-10-326	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	41.03	0.41	80.29
CLQCA-10-330	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	S	+	-	42.08	0.42	82.35
CLQCA-10-384	Archaeological vessels	+	-	+	+	-	W	-	-	W	-	+	L	-	S	+	-	38.26	0.38	74.87
CLQCA-10-385	Archaeological vessels	+	-	+	L	-	+	+	-	W	-	W	+	-	+	W	-	40.08	0.40	78.43
CLQCA-10-386	Archaeological vessels	+	-	+	L	-	+	+	-	W	-	W	W	-	+	W	-	42.14	0.42	82.46
CLQCA-10-675	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	S	-	44.38	0.44	86.85
CLQCA-10-694	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	43.26	0.43	84.65
CLQCA-11-024	Vegetal material	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	43.23	0.43	84.60
CLQCA-11-027	Vegetal material	+	-	+	+	-	+	+	W	+	-	+	+	-	+	+	-	41.32	0.41	80.86
CLQCA-13-023	Fatty material	+	-	+	+	-	+	+	-	+	-	+	+	-	+	S	-	42.02	0.42	82.23
CLQCA-13-024	Fatty material	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	43.17	0.43	84.48
CLQCA-14-006	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	S	-	42.21	0.42	82.60
CLQCA-14-007	Fermented beverages	+	-	+	+	-	+	+	W	+	-	+	+	-	+	S	-	44.46	0.44	87.00
CLQCA-14-008	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	S	-	43.23	0.43	84.60
CLQCA-14-010	Fermented beverages	+	-	S	S	-	+	+	-	+	-	+	+	-	+	S	-	43.46	0.43	85.05
CLQCA-14-013	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	S	-	41.12	0.41	80.47
CLQCA-14-015	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	42.34	0.42	82.85

CLQCA-17-060	Insect	+	-	+	+	-	+	+	-	+	-	+	+	-	+	S	-	44.18	0.44	86.45
CLQCA-17-111	Vegetal material in decomposition	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	43.06	0.43	84.26
CLQCA-18-003	Vegetal material	+	-	+	+	-	+	+	-	+	-	+	+	-	+	S	-	43.14	0.43	84.42
CLQCA-18-006	Vegetal material	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	44.28	0.44	86.65
CLQCA-18-008	Vegetal material	+	-	+	S	-	+	+	-	+	-	+	+	-	+	+	-	41.12	0.41	80.47
CLQCA-19-001	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	S	-	44.08	0.44	86.26
CLQCA-19-011	Animal excrement	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	40.12	0.40	78.51
CLQCA-20-060	Water	+	-	S	+	-	+	+	-	+	-	+	+	-	+	+	-	41.11	0.41	80.45
CLQCA-20-072	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	S	-	42.26	0.42	82.70
CLQCA-20-073	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	42.43	0.42	83.03
CLQCA-20-075	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	43.03	0.43	84.20
CLQCA-20-080	Fermented beverages	+	-	+	S	-	+	+	-	+	-	+	+	-	+	+	-	41.28	0.41	80.78
CLQCA-20-081	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	S	-	39.32	0.39	76.94
CLQCA-20-082	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	43.26	0.43	84.65
CLQCA-20-083	Fermented beverages	+	-	S	+	-	+	+	-	+	-	+	+	-	+	+	-	43.32	0.43	84.77
CLQCA-20-084	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	S	-	38.36	0.38	75.07
CLQCA-20-085	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	42.32	0.42	82.81
CLQCA-20-088	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	44.27	0.44	86.63
CLQCA-20-089	Fermented beverages	+	-	+	S	-	+	+	-	+	-	+	+	-	+	+	-	43.03	0.43	84.20
CLQCA-20-090	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	S	-	44.01	0.44	86.12
CLQCA-20-092	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	43.48	0.43	85.08
CLQCA-20-093	Fermented beverages	+	-	S	+	-	+	+	-	+	-	+	+	-	+	+	-	43.2	0.43	84.54
CLQCA-20-098	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	S	-	41.24	0.41	80.70
CLQCA-20-099	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	40.3	0.40	78.86
CLQCA-20-100	Fermented beverages	+	-	S	+	-	+	+	-	+	-	+	+	-	+	+	-	41.18	0.41	80.58
CLQCA-20-102	Fermented beverages	+	-	+	S	-	+	+	-	+	-	+	+	-	+	+	-	42.2	0.42	82.58
CLQCA-20-104	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	S	-	42.34	0.42	82.85
CLQCA-20-105	Fermented beverages	+	-	+	S	-	+	+	-	+	-	+	+	-	+	+	-	43.16	0.43	84.46
CLQCA-20-109	Fermented beverages	+	-	S	S	-	+	+	-	+	-	+	+	-	+	+	-	38.24	0.38	74.83
CLQCA-20-120	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	S	-	42.54	0.42	83.25
CLQCA-20-121	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	41.22	0.41	80.66

CLQCA-20-122	Fermented beverages	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	44.28	0.44	86.65
CLQCA-20-124	Fermented beverages	+	-	+	S	-	+	+	-	+	-	+	+	-	+	+	-	43.36	0.43	84.85
CLQCA-20-128	Fermented beverages	+	-	S	+	-	+	+	-	+	-	+	+	-	+	S	-	42.37	0.42	82.91
CLQCA-20-156	Vegetal material	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	42.26	0.42	82.70
CLQCA-20-184	Vegetal material	+	-	S	+	-	+	+	-	+	-	+	+	-	+	+	-	41.09	0.41	80.41
CLQCA-20-221	Vegetal material	+	-	+	+	-	+	+	-	+	-	+	+	-	+	S	-	44.26	0.44	86.61
CLQCA-20-246	Termite nest	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	43.05	0.43	84.24
CLQCA-20-248	Soil	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	44.34	0.44	86.77
CLQCA-20-259	Vegetal material in decomposition	+	-	S	+	-	+	+	-	+	-	+	+	-	+	+	-	41.42	0.41	81.05
CLQCA-20-314	Termite nest	+	-	+	+	-	+	+	-	+	-	+	+	-	+	S	-	44.64	0.45	87.35
CLQCA-20-368	Vegetal material in decomposition	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	41.23	0.41	80.68
CLQCA-23-002	Archaeological vessels	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	42.52	0.42	83.21
CLQCA-24SC-054	Fermented beverages	+	-	+	+	+	+	+	+	+	-	+	+	-	-	W	-	42.11	0.42	82.40
CLQCA-24SC-055	Fermented beverages	+	-	+	+	W	+	+	W	W	-	W	+	-	+	+	-	41.02	0.41	80.27
CLQCA-24SC-056	Fermented beverages	+	-	+	+	L	+	+	L	W	-	+	W	-	W	W	-	43.25	0.43	84.63
CLQCA-24SC-057	Fermented beverages	+	-	+	+	W	+	+	W	W	-	+	+	-	+	+	-	44.28	0.44	86.65
CLQCA-24SC-067	Fermented beverages	+	-	+	+	W	+	+	+	W	-	+	+	-	+	-	-	41.16	0.41	80.54
CLQCA-24SC-069	Fermented beverages	+	-	+	+	W	+	+	L	+	-	+	+	-	+	+	-	41.56	0.41	81.33
CLQCA-24SC-071	Fermented beverages	+	-	+	+	W	+	+	L	W	-	+	+	-	-	W	-	44.28	0.44	86.65
CLQCA-24SC-137	Fermented beverages	+	-	+	+	-	+	+	W	-	-	W	+	-	W	-	-	40.08	0.40	78.43
CLQCA-24SC-138	Fermented beverages	+	-	+	+	-	+	+	-	-	-	-	+	-	-	W	-	42.34	0.42	82.85

CLQCA-24SC-235	Vegetal exudate	+	-	+	+	-	+	+	-	+	-	+	-	-	L	+	-	37.54	0.37	73.46
CLQCA-INT-001	Commercial yeast	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	47.14	0.47	92.25
CLQCA-INT-002	Commercial yeast	+	-	+	+	-	+	+	W	+	-	+	-	-	+	+	-	45.09	0.45	88.24
CLQCA-INT-003	Commercial yeast	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	44.18	0.44	86.45
CLQCA-INT-004	Commercial yeast	+	-	+	+	W	+	+	-	+	-	+	+	-	+	+	-	41.22	0.41	80.66
CLQCA-INT-005	Commercial yeast	+	-	+	+	-	+	+	W	+	-	+	+	-	+	+	-	49.08	0.49	96.04
CLQCA-INT-006	Commercial yeast	+	-	+	-	-	+	+	-	+	-	+	-	-	+	+	-	44.12	0.44	86.34
CLQCA-INT-009	Commercial yeast	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	40.32	0.40	78.90
CLQCA-INT-012	Commercial yeast	+	-	+	-	-	+	+	-	+	-	+	-	-	+	W	-	41.21	0.41	80.64
CLQCA-INT-013	Commercial yeast	+	-	+	-	-	+	+	W	+	-	+	-	-	+	+	-	42.42	0.42	83.01
CLQCA-INT-014	Commercial yeast	+	-	+	-	-	+	+	-	+	-	+	-	-	+	+	-	38.61	0.39	75.55
CLQCA-INT-025	Commercial yeast	+	-	+	+	-	+	+	-	+	-	+	+	-	W	+	-	40.08	0.40	78.43
CLQCA-INT-026	Commercial yeast	+	-	W	W	-	+	+	-	-	-	-	-	-	-	-	-	42.08	0.42	82.35
CLQCA-INT-027	Commercial yeast	+	-	+	+	-	+	+	-	-	-	-	-	-	-	-	-	44.01	0.44	86.12
CLQCA-INT-029	Commercial yeast	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	43.22	0.43	84.58
CLQCA-INT-031	Commercial yeast	+	-	+	+	-	+	+	-	+	-	+	L	-	+	+	-	43.35	0.43	84.83
CLQCA-INT-032	Commercial yeast	+	-	+	+	W	+	+	-	+	-	+	+	-	+	W	-	39.28	0.39	76.87
CLQCA-INT-033	Commercial yeast	+	-	+	+	-	-	+	-	+	-	+	+	-	-	+	-	41.27	0.41	80.76
CLQCA-INT-034	Commercial yeast	+	-	+	+	-	+	+	-	+	-	+	W	-	+	+	-	43.37	0.43	84.87
CLQCA-INT-041	Commercial yeast	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	40.33	0.40	78.92
CLQCA-INT-043	Commercial yeast	+	-	+	+	-	+	+	-	+	-	+	L	-	+	+	-	41.16	0.41	80.54
CLQCA-INT-046	Commercial yeast	+	-	+	+	W	+	+	-	+	-	+	+	-	+	W	-	42.28	0.42	82.74
CLQCA-INT-083	Commercial yeast	+	-	+	+	-	-	+	-	+	-	+	+	-	-	+	-	43.16	0.43	84.46
UCLM325	Commercial yeast	+	-	+	+	-	+	+	-	+	-	+	+	-	+	+	-	46.11	0.46	90.23

Glu: glucose; Xyl: xylose; Mal: maltose; Gal: galactose; Lac: lactose; Suc: sucrose; Raf: raffinose; Cel: cellobiose