Development of an optimal commercial formulation from European Union-registered strains for fermentation of green forage.

Wambacq, L.; Latre, H.
HoGent University, April 2022.

Objective: To determine what combination and ratio of strains consistently preserves the maximum nutritive value of a range of ensiled forages.

Experimental design: A series of third cut forages (meadow grass, grass-clover mix and alfalfa) were wilted, chopped and ensiled in replicated mini silos at 265, 246 and 230 KgDM m^{-3} respectively. Silos were ensiled for a period of 100 days prior to analysis for fermentation and aerobic characteristics, as per Honig, following treatment with a combination of lactic acid bacteria applied at a total of 1,000,000 cfu/g forage. Treatments were potential variations of EU-approved strains with or without a novel stimulant.

Post 100-day analysis of different treatments by wet chemistry and aerobic assessment are:

Meadow grass

	g/Kg corrected dry matter (CDM)										Aerobic assessment		
	Loss % fresh material (FM)	Corrected dry matter (CDM)	pH	Crude protein (CP)	Ammonia (NH_3)	Lactic acid (LA)	Acetic acid (AA)	Ethanol (EtOH)	Water soluble carbohyd-rate (WSC)	Ammonia as a % of total nitrogen (NH_3 %TN)	Stability hours	Max tempera-ture reached (Max T °C)	Hours Tmax
Control	1.21	409.1	4.38	117.4	2.5	56.4	9.9	20.8	33.3	9.8	182	30	224
Test 1	0.57	402.8	3.87	117.9	1.1	74.4	0.0	14.3	47.2	4.5	65	30	138
Egalis™ Ferment	0.53	406.2	3.87	120.2	1.5	75.1	0.0	13.4	43.6	5.9	122	32	191
Test 2	0.66	403.0	3.94	121.6	2.9	69.1	0.0	14.3	43.8	10.9	91	31	183
Test 3	0.73	403.5	3.94	123.8	4.2	71.2	0.0	14.7	UD	14.9	90	33	182
Test 4	0.65	412.0	3.92	122.2	4.4	73.2	0.0	14.4	UD	15.8	127	33	186
Test 5	0.68	403.3	3.87	119.0	4.6	74.0	0.0	15.3	UD	16.7	69	32	137
Test 6	0.58	398.2	3.88	118.1	4.0	76.0	0.0	15.3	UD	14.6	75	32	187
Test 7	0.64	397.5	3.92	122.5	5.0	71.1	0.0	15.1	UD	17.4	91	33	188

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Grass-clover: 50% mix in ley.

	g/Kg corrected dry matter (CDM)										Aerobic assessment		
	Loss % fresh material (FM)	Corrected dry matter (CDM)	pH	Crude protein (CP)	Ammonia (NH_3)	Lactic acid (LA)	Acetic acid (AA)	Ethanol (EtOH)	Water soluble carbohyd-rate (WSC)	Ammonia as a % of total nitrogen (NH_3 %TN)	Stability hours	Max tempera-ture reached (Max T °C)	Hours Tmax
Control	0.82	492.8	4.36	129	3.1	58.6	14.4	14.1	4.6	10.9	235	20	140
Test 1	0.57	490.1	4.15	137	1.4	80.1	10.5	10.9	4.8	5.0	191	24	169
Egalis Ferment	0.65	488.6	4.17	139	1.5	82.1	11.2	10.8	4.8	5.4	225	22	195
Test 2	0.66	489.8	4.18	138	2.2	80.9	7.0	11.3	4.9	7.6	198	25	183
Test 3	0.69	490.5	4.18	136	3.6	85.8	11.5	11.1	4.7	12.1	221	22	139
Test 4	0.62	491.5	4.17	133	4.4	76.3	8.4	10.6	4.7	14.4	230	20	198
Test 5	0.59	492.6	4.15	142	4.2	80.6	8.6	10.9	5.1	13.1	231	21	64
Test 6	0.67	490.6	4.17	142	4.4	81.6	9.5	11.4	4.6	13.8	216	23	106
Test 7	0.64	490.1	4.18	139	3.8	79.9	8.6	11.3	5.8	12.1	226	21	68

Alfalfa

	g/Kg corrected dry matter (CDM)										Aerobic assessment		
	Loss % fresh material (FM)	Corrected dry matter (CDM)	pH	Crude protein (CP)	Ammonia (NH_3)	Lactic acid (LA)	Acetic acid (AA)	Ethanol (EtOH)	Water soluble carbohyd-rate (WSC)	Ammonia as a % of total nitrogen (NH_3 %TN)	Stability hours	Max tempera-ture reached (Max T °C)	Hours Tmax
Control	1.14	355.0	4.89	185	4.9	59.4	43.7	20.2	3.8	12.2	>240	19.0	27.0
Test 1	0.93	355.4	4.72	179	4.1	65.6	36.7	17.4	3.8	10.5	>240	19.2	28.8
Egalis Ferment	0.91	356.2	4.73	166	4.3	67.6	35.4	18.2	3.8	12.1	>240	19.3	28.0
Test 2	0.8	356.4	4.66	161	3.8	67.2	30.3	17.0	3.8	10.6	>240	18.9	28.5
Test 3	0.86	353.5	4.70	165	4.3	67.7	31.6	16.7	3.8	11.6	>240	18.5	25.2
Test 4	0.75	353.7	4.62	170	3.4	66.8	28.2	14.7	3.9	9.3	>240	19.5	28.8
Test 5	0.74	355.9	4.61	166	3.3	66.3	33.4	14.7	3.8	9.3	>240	19.2	29.2
Test 6	0.84	354.3	4.68	170	3.8	68.7	36.1	14.9	3.8	10.5	>240	19.2	26.2
Test 7	0.82	354.2	4.65	179	4.2	70.0	32.9	15.4	3.8	10.8	>240	19.5	27.4

Key observations:

- All of the potential combinations of ratios and strains of bacteria enhanced the overall fermentation characteristics of the three forage types used within the assessment. The pH of the final silage was consistently lower than the control silage, with a consistent shift in the fermentation parameters toward a more homofermentative fermentation profile (elevated lactic acids and reduced acetic acids).
- The untreated silage in every assessment produced a successful homofermentative, indicating optimal ensiling conditions.
- The speed of fermentation of all of the potential combinations of ratios and strains of bacteria was increased. This occurred even under the optimal ensiling conditions, as shown by the large reduction in alcohol production associated with treatment and the reduced dry matter losses.
- A consistent pattern was observed across treatment options with regard to the preservation of protein as shown by the levels of ammonia nitrogen associated with the different treatments.
- Higher-sugar forage (which is easier to ensile) was more prone to aerobic instability and had a lower aerobic stability than low-sugar forage, but treatment had a negligible impact on the maximum temperature achieved.
- The homofermentative treatment of low-sugar forage has a negligible impact on aerobic stability, which was typically stable for 9–10 days and had a variable impact on high-sugar forage.

Conclusion:

These assessments, in parallel with other forage and bacterial assessments, has led to the selection of *Lactiplantibacillus plantarum* IMI 507026 at 500,000 cfu/g applied plus *Pediococcus pentosaceus* IMI 507025 at 500,000 cfu/g applied (for a total of 1,000,000 cfu/g forage applied) as the optimal formulation for Egalis Ferment.

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