Kérődző Workshop

2024. február 21., szerda
Székesfehérvár

Silózási gyakorlati tanácsok az elmúlt évek magyarországi tapasztalatai alapján

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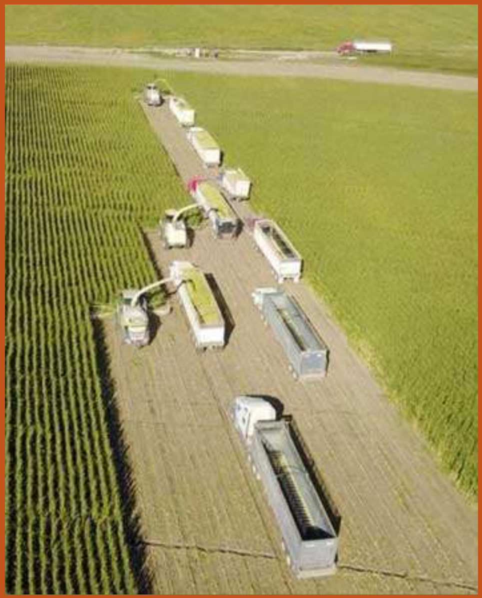
EGALIS™

Minőségi szilázs = jobb jövedelmezőség a telepen

Gyakorlati megközelítés: hogyan érjünk el jó minőségű szilázst és csökkentsük a veszteségeinket?

A szántóföldtől a jászolig



Környezet és mikrobiológia kontrollja

\+

<8 – 10% veszteség
Alacsony GHG
Jó ízletesség
Jó takarmány hasznosítás

\-

25% feletti veszteség
Magas GHG
Nem megfelelő ízletesség
Rossz takarmány hasznosítás

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A szilázsminőséget befolyásoló tényezők

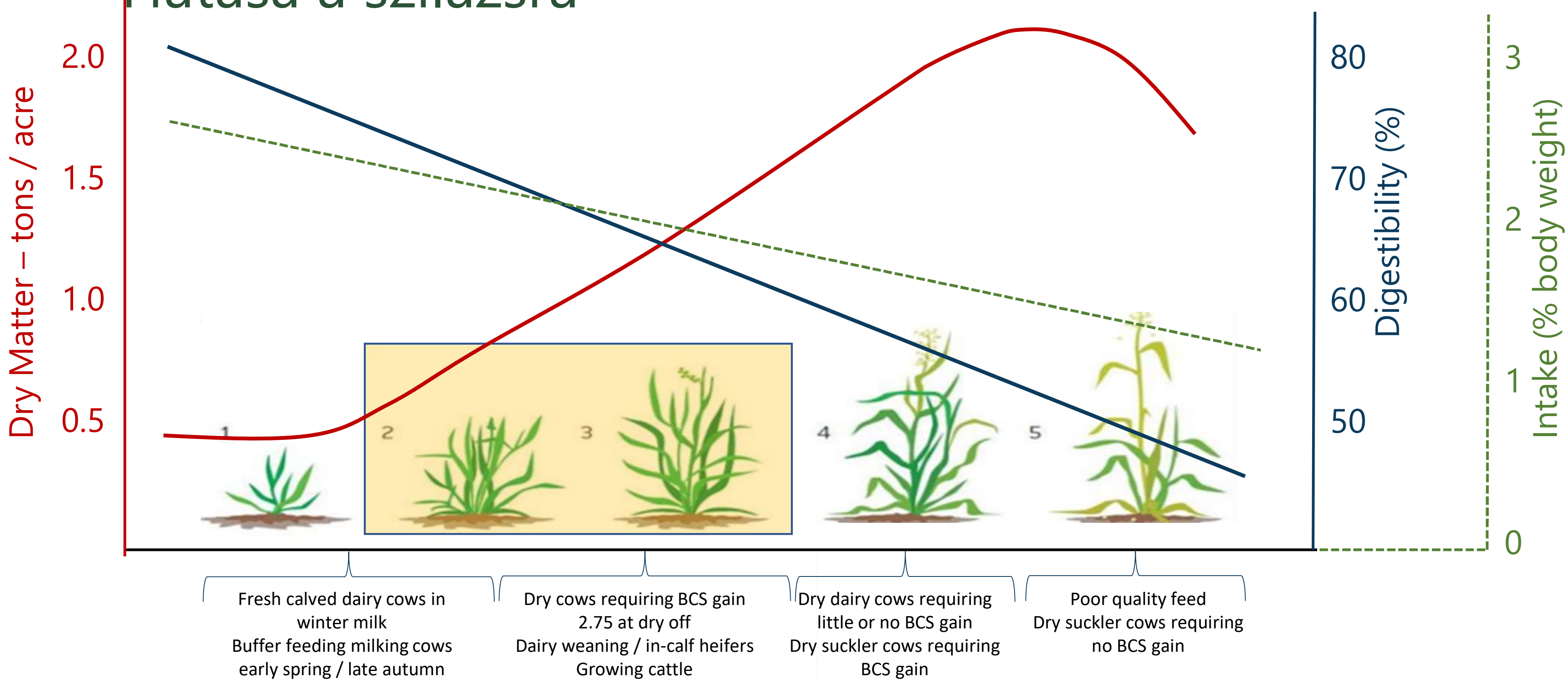
- **Időzítés (fenofázis)**
- Szárazanyag tartalom
- Szecskahossz
- Adalékanyag
- Tömörítés
- Higiénia a betakarítás és besilózás során

- Silózáskori hőmérséklet
- Betakarítási idő
- Takarás
- Tárolási management
- Kitárolási management

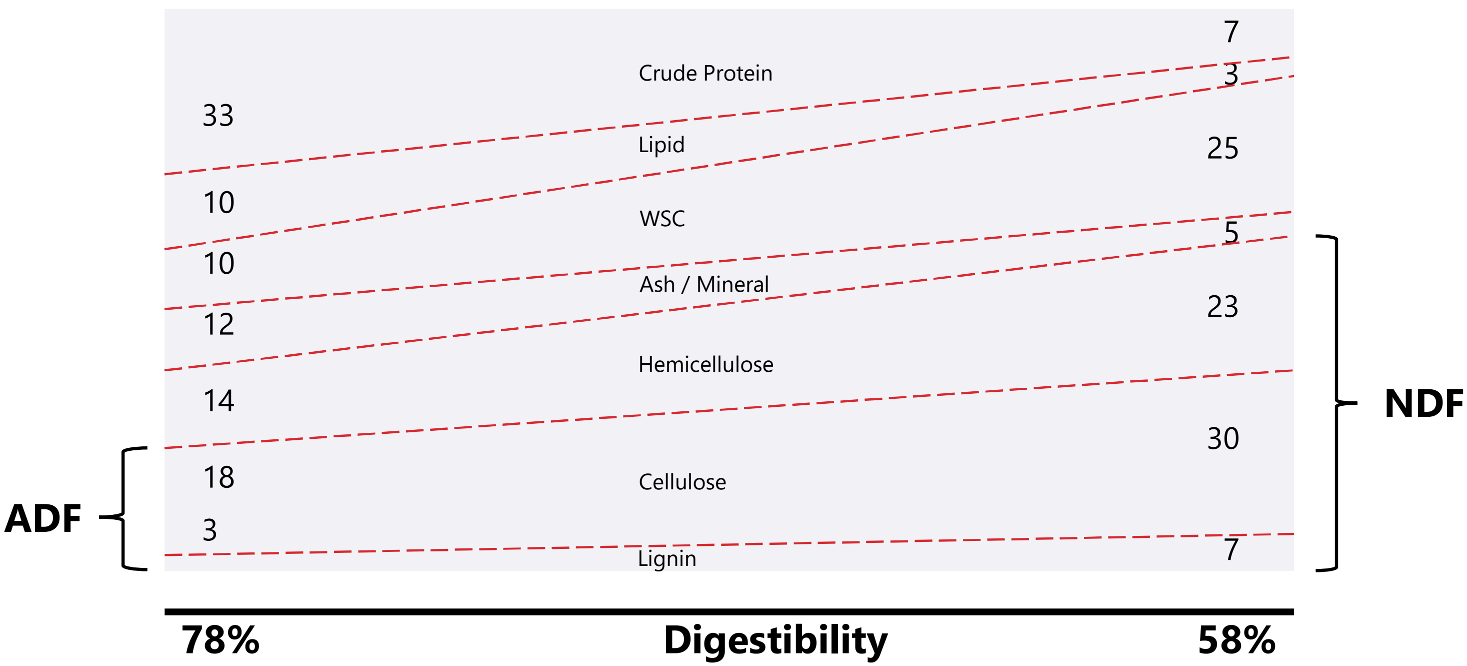
Növekedési szakasz

Fű növekedési szakaszai

Hatása a szilázsra

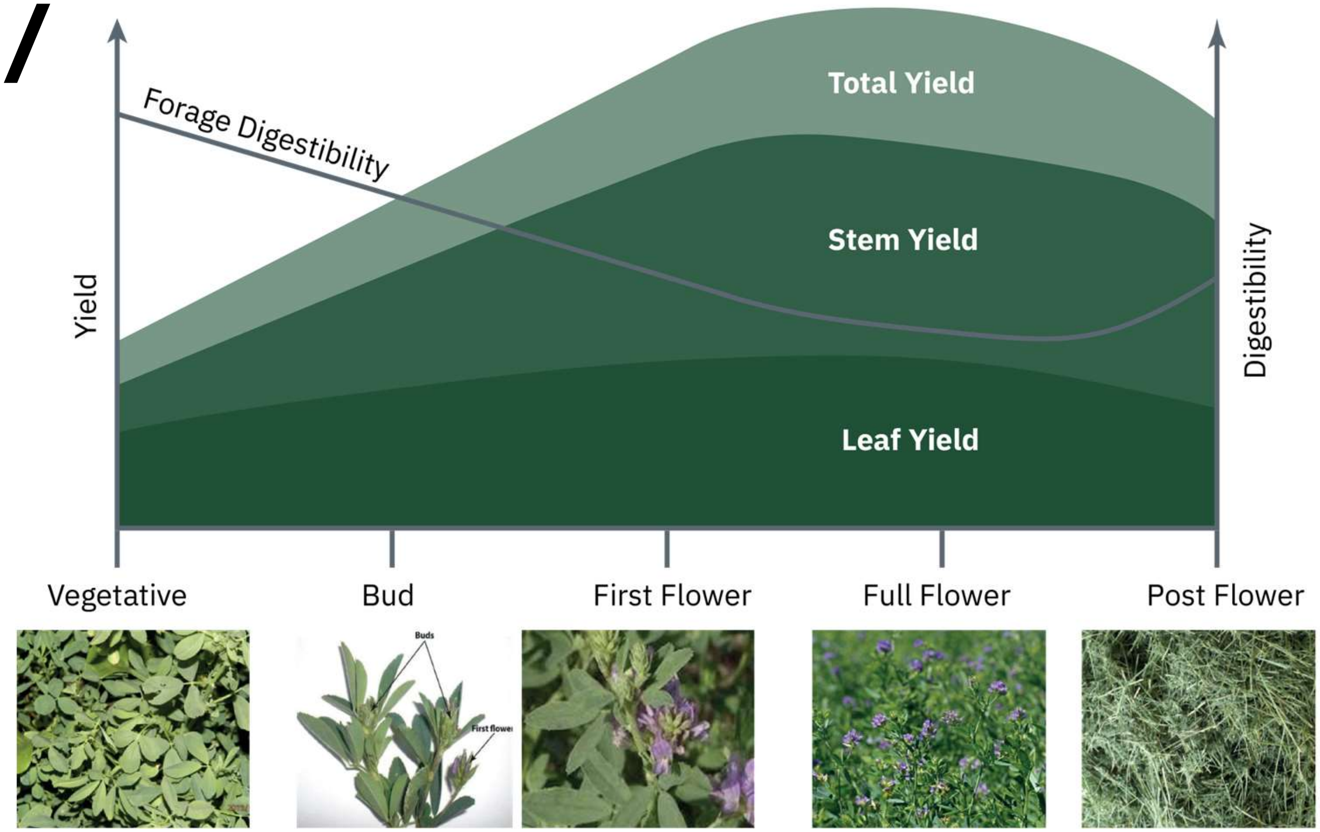


Változások a friss fűben



Modified Beever *et al*, 2000

Lucerna hozam / minőség alkuja



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Levél vs szár

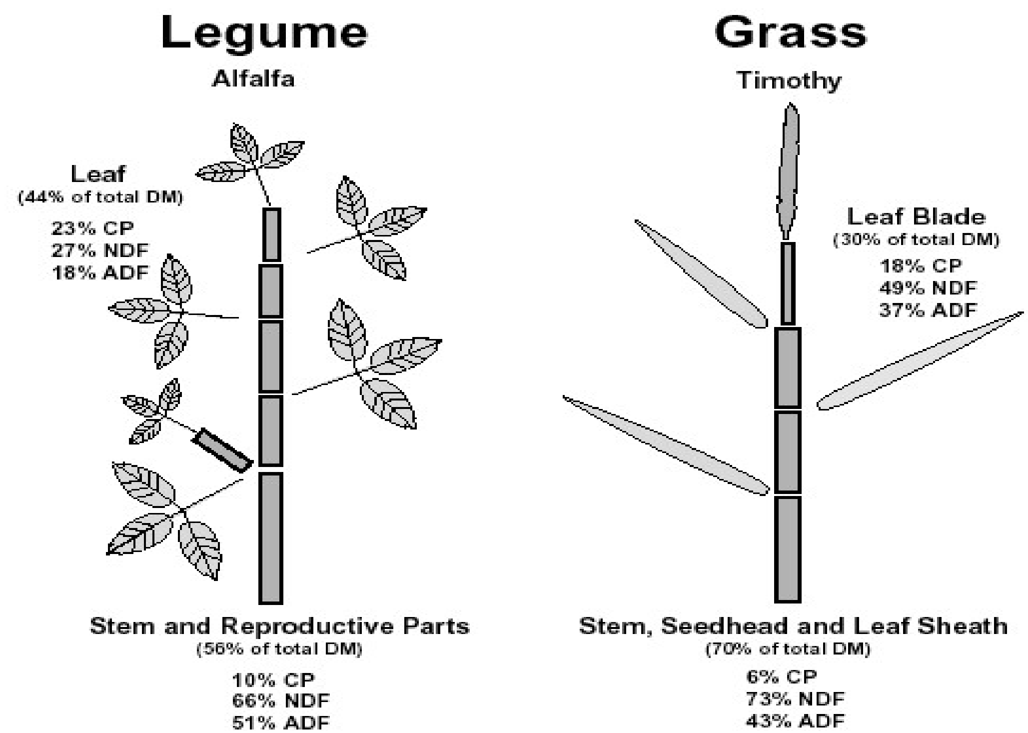


Fig. 16.6. Forage quality analysis of leaf and stem tissue from alfalfa and timothy growing together in a mixture (Collins, 1988). From Forages Vol. I, An Introduction to Grassland Agriculture, 6th ed.

Szárazanyag

Talaj baktériumok

- Count of 1million – 100 million per g

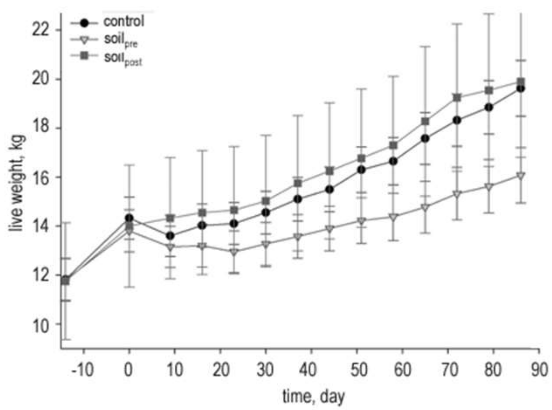


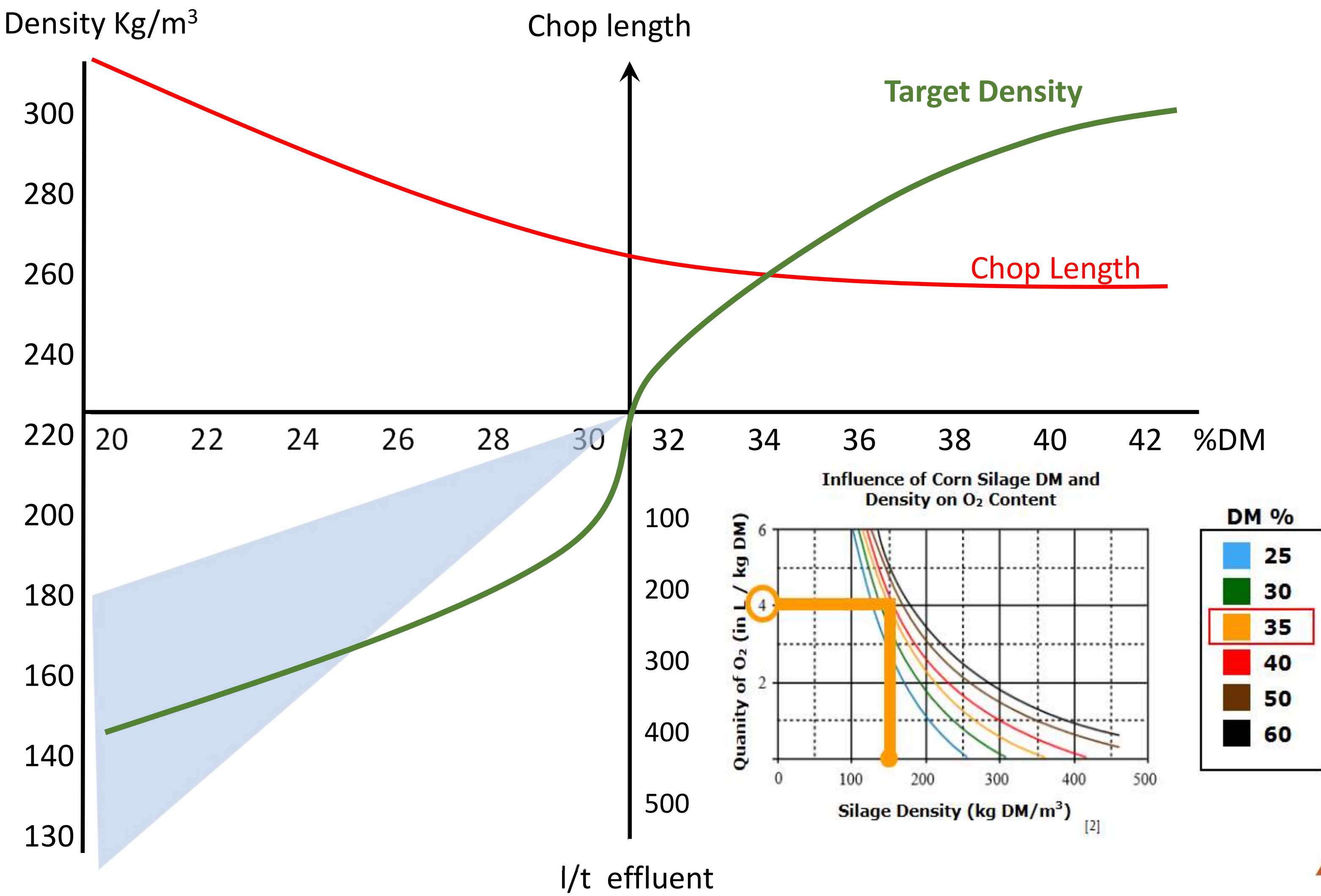
Figure 1. Live weight development of animals fed one of the treatments: control – without soil contamination, Soil$_{pre}$ – soil contamination before ensiling, Soil$_{post}$ – soil contamination after ensiling, just before feeding (means, error bars indicate standard error of the mean, n = 8)

Table 4. Dry matter intake (DMI) and Fe intake per animal per day and growth performance from experimental days 8 to 85, feeding trial (means ± standard deviation)

Indices	Treatment[1] Control (n = 4)	Soil$_{pre}$ (n = 4)	Soil$_{post}$ (n = 4)	*P*-value
Daily DMI, g/animal	387^{ab} ± 52.3	312^{b} ± 43.8	438^{a} ± 30.9	0.006
Daily Fe intake, g/animal	135^{c} ± 18.2	534^{b} ± 75.1	874^{a} ± 95.5	< 0.001
LW, kg (n = 8)				
day 0	14.3 ± 2.3	13.8 ± 2.5	14.0 ± 2.5	0.91
day 85	19.6 ± 3.5	16.1 ± 3.0	19.9 ± 3.1	0.048
Daily LWG, g/animal	78^{a}	38^{b}	72^{a}	0.002
Feed conversion, kg DMI/kg LWG	5.0^{b}	9.0^{a}	5.9^{b}	0.012

[1] Treatments: Control – without soil contamination, Soil$_{pre}$ – soil contamination before ensiling, Soil$_{post}$ – soil contamination after ensiling, just before feeding; DMI dry matter intake; LW – live weight; LWG – live weight gain; ^{abc} – values with different superscripts within a row are significantly different at $P < 0.05$ (Tukey-HSD)

Martens et al, JAFS, 27, 2018, 307-16


Density Kg/m3
Chop length
Target Density
Chop Length
300
280
260
240
220
200
180
160
140
130
20
22
24
26
28
30
32
34
36
38
40
42
%DM
100
200
300
400
500
l/t effluent
Influence of Corn Silage DM and Density on O2 Content
Quanity of O2 (in L / kg DM)
Silage Density (kg DM/m3)
[2]
DM %
25
30
35
40
50
60

Szárazanyag

32% Dry Matter Forage

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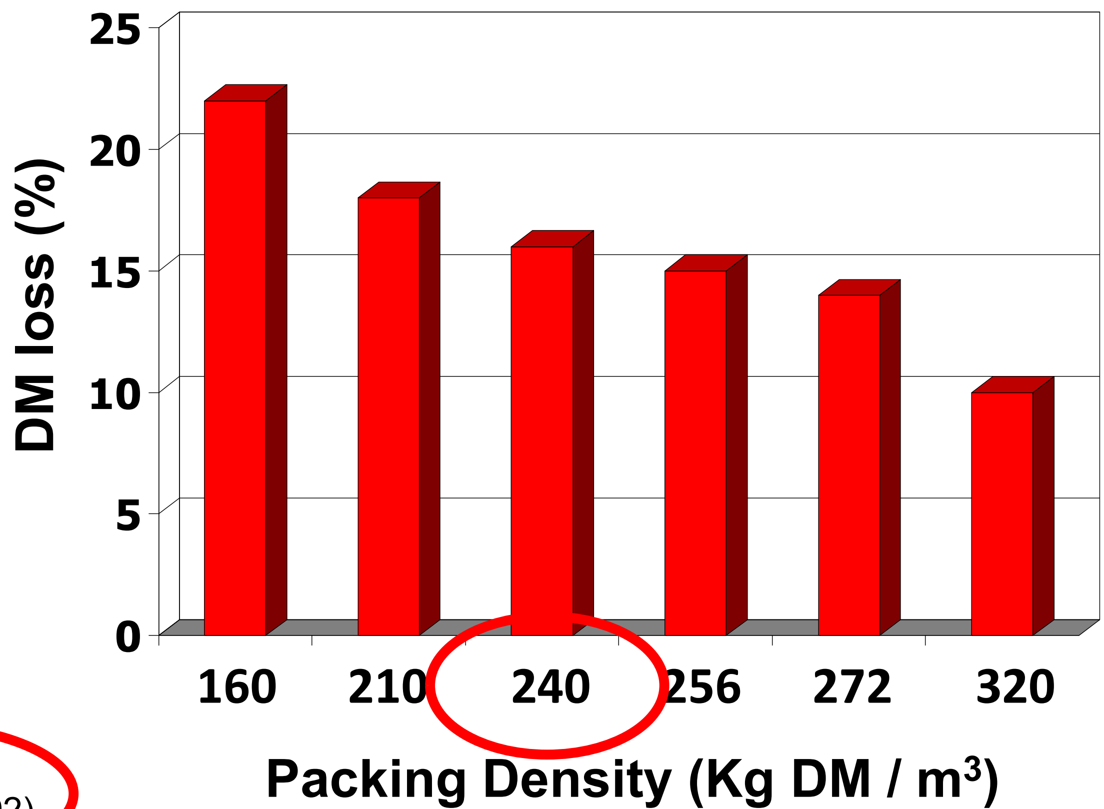
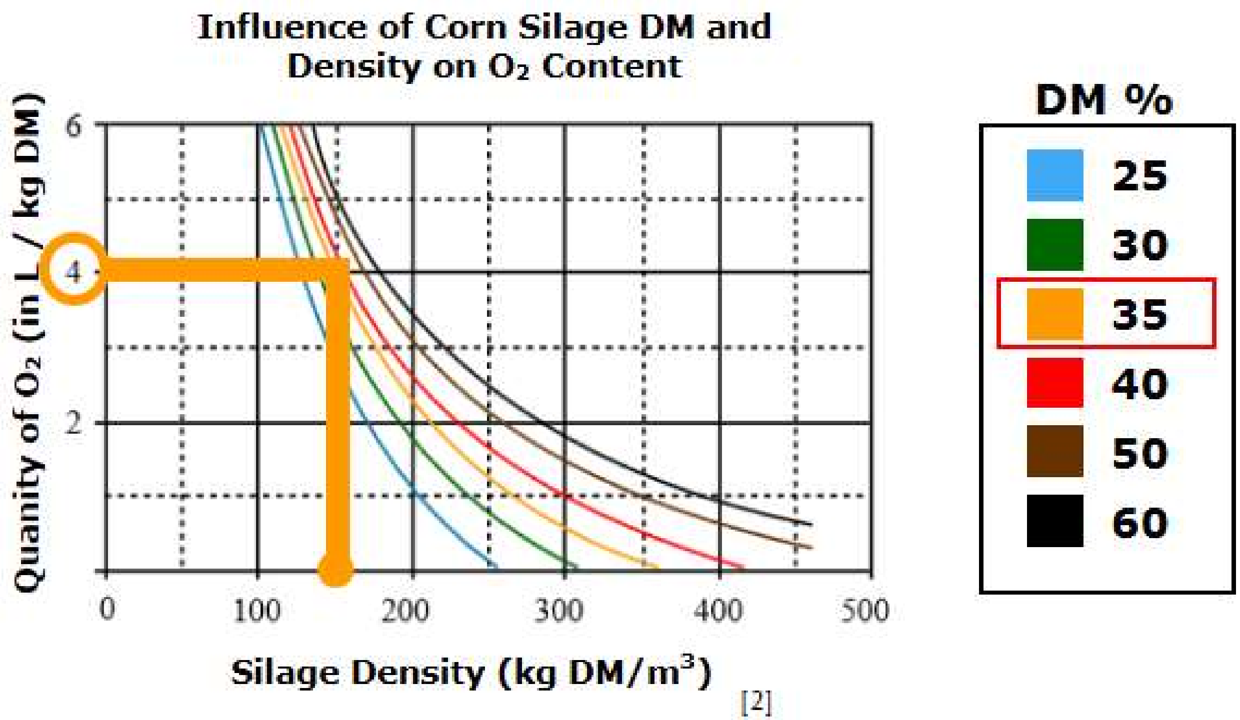
Légrések

Tömörség vagy légrések



(Adapted Ruppel, 1992)

Légrés = Levegő mennyisége



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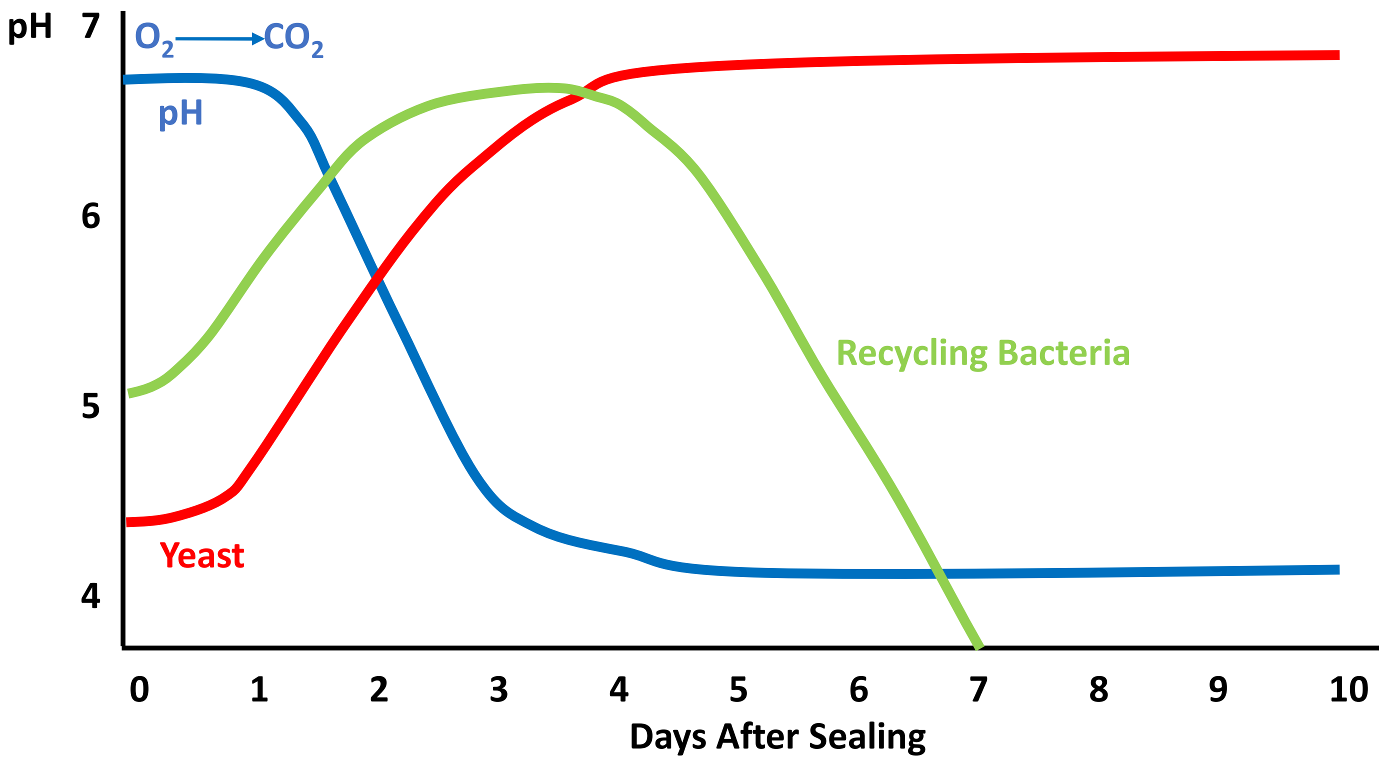
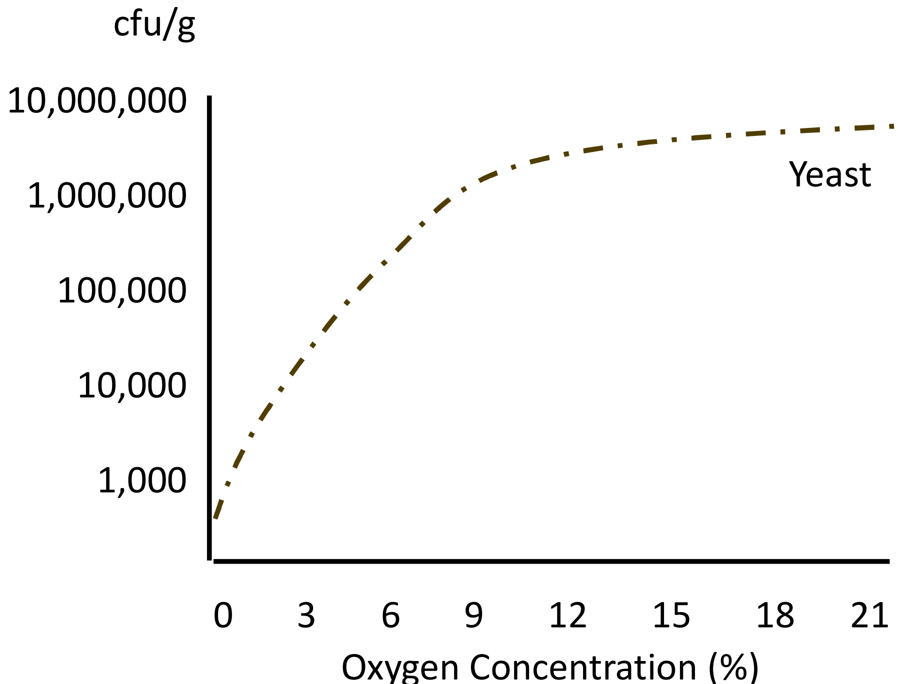


pH
7
6
5
4
O_2 → CO_2
pH
Yeast
Recycling Bacteria
0
1
2
3
4
5
6
7
8
9
10
Days After Sealing

Oxigén mérése



Adapted: Williams

Adalék

Baktériumok hatékonysága

Table 1. Losses of DM and gross energy from some silage fermentation pathways (McDonald et al., 1991; Rooke and Hatfield, 2003)[1]

				Loss (% substrate)	
Organism	Pathway	Substrate	Products	DM	Gross energy
LAB	Ho	Glucose	2 lactate	0	0.7
LAB	He	Glucose	1 lactate, 1 ethanol, 1 CO_2	24	1.7
LAB	He	3 Fructose	1 lactate, 1 acetate, 2 mannitol, 1 CO_2	4.8	1.0
LAB	Ho/He	2 Citrate	1 lactate, 3 acetate, 3 CO_2	29.7	−1.5
LAB	Ho/He	Malate	1 lactate, 1 CO_2	32.8	−1.8
Enterobacteria		2 Glucose	2 lactate, 1 acetate, 1 ethanol, 2 CO_2	17	11.1
Clostridia		2 Lactate	1 butyrate, 2 CO_2, 2 H_2	51.1	18.4
Yeasts		Glucose	2 ethanol, 2 CO_2	48.9	0.2

[1]LAB = lactic acid bacteria; Ho = homofermentative; He = heterofermentative.

A friss tömegtakarmány összetétele

Items	Fresh alfalfa	Fresh red clover	Fresh Italian ryegrass	Sterile Italian ryegrass	*p*-value
					IRFM vs. STIR
pH	6.21	6.02	6.07	6.06	0.058
Dry matter (g/kg FW)	264	262	247	244	0.862
Water-soluble carbohydrates (g/kg DM)	79.5	73.3	122	120	0.541
Buffering capacity (mEq/kg DM)	314	311	83.8	82.4	0.214
Neutral detergent fiber (g/kg DM)	398	396	561	564	0.856
Acid detergent fiber (g/kg DM)	227	242	344	341	0.867
Acid detergent lignin (g/kg DM)	78.5	84.1	87.3	86.5	0.217
Crude protein (g/kg DM)	224	247	90.0	87.0	0.334
Lactic acid bacteria ($\log_{10}$ cfu/g FW)	6.51	4.64	5.22	ND	–
Aerobic bacteria ($\log_{10}$ cfu/g FW)	7.66	7.51	7.14	ND	–
Yeasts ($\log_{10}$ cfu/g FW)	6.57	6.54	6.41	ND	–
Enterobacteriaceae ($\log_{10}$ cfu/g FW)	7.79	6.72	8.25	ND	–

DM, dry matter; FW, fresh weight; mEq, milligram equivalent; cfu, colony-forming units; ND, not detected; IRFM, fresh Italian ryegrass; STIR, sterile Italian ryegrass.

LAB : Others	**1 : 17**	**1 : 93**	**1 : 122**

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Mi befolyásolja a takarmány felvételt?

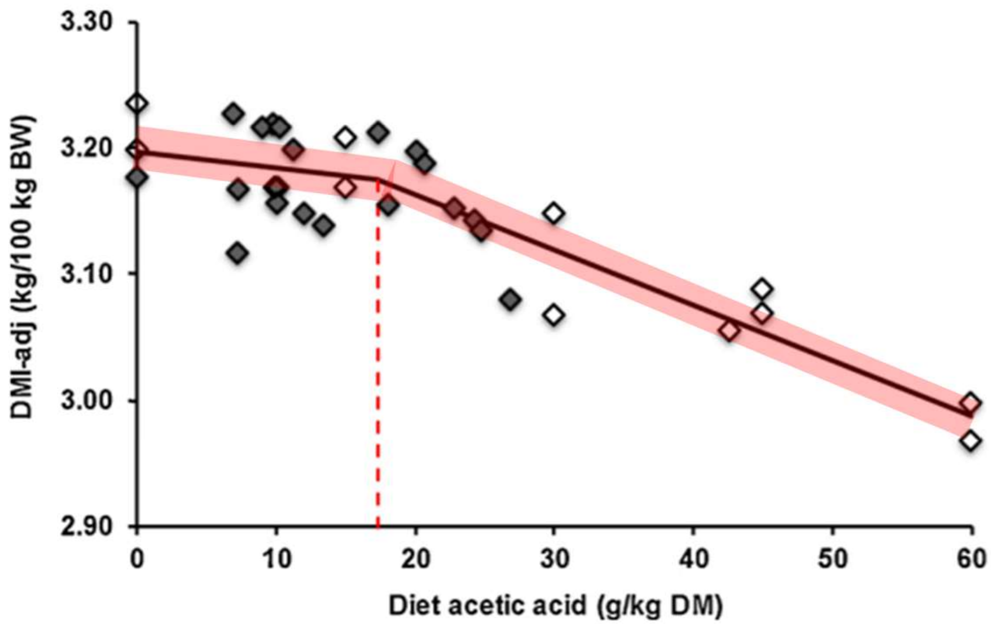
No.	Component	r	Significance of r	Significance of JK
1	DM	0.630	0.001	0.701
2	OMD	0.257	0.226	0.593
3	Crude protein	−0.322	0.125	0.940
4	NDF	0.200	0.349	0.042
5	ADF	−0.332	0.113	0.325
6	ADL	−0.237	0.264	0.065
7	OM	0.071	0.743	0.323
8	Ether extract	−0.244	0.250	0.693
9	WSC	0.279	0.186	0.240
10	Ethanol	−0.288	0.172	0.629
11	PH	−0.037	0.865	0.072
12	Acetic acid	−0.642	0.001	0.073
13	Propionic acid	−0.740	0.000	0.111
14	Butyric acid	−0.430	0.036	0.799
15	Total VFA	−0.639	0.001	0.013
16	Lactic acid (LA)	0.125	0.562	0.175
17	Total acids (TA)	−0.553	0.005	0.001
18	LA/TA	0.495	0.014	0.120
19	Non-protein N	0.249	0.241	0.498
20	True soluble protein	−0.003	0.991	0.718
21	ADIN	−0.433	0.035	0.498
22	NH_3-N	−0.373	0.073	0.213
23	2-phenyl-ethylamine	−0.207	0.332	0.879
24	Histamine	−0.529	0.008	0.245
25	Tryptamine	−0.677	0.000	0.663

No.	Component	r	Significance of r	Significance of JK
26	Tyramine	−0.331	0.114	0.494
27	Putrescine	−0.242	0.255	0.286
28	Cadaverine	−0.476	0.019	0.347
29	Total amines	−0.436	0.033	0.766
30	Ethanal	−0.198	0.354	0.320
31	Dimethyl sulphide	0.171	0.423	0.172
32	Propanal	−0.356	0.088	0.523
33	2-methyl propanal	−0.084	0.698	0.743
34	Methyl ethanoate	0.453	0.026	0.085
35	Ethyl ethanoate	0.281	0.183	0.090
36	Methanol	−0.301	0.154	0.012
37	2-methyl butanal	−0.070	0.746	0.130
38	3-methyl butanal	0.016	0.940	0.209
39	Ethyl propanoate	−0.084	0.698	0.055
40	Propyl ethanoate	−0.222	0.296	0.834
41	Methyl butanoate	−0.055	0.800	0.889
42	2-Butanol	−0.007	0.972	0.352
43	1-Propanol	−0.448	0.028	0.005
44	Ethyl butanoate	−0.007	0.975	0.724
45	Butyl ethanoate	−0.596	0.002	0.159
46	Methyl pentanoate	−0.177	0.408	0.465
47	Propyl butanoate	−0.315	0.134	0.689
48	Ethyl pentanoate	−0.599	0.002	0.776
49	Methyl hexanoate	−0.651	0.001	0.327
50	Butyl butanoate	−0.583	0.003	0.977
51	Ethyl hexanoate	−0.633	0.001	0.575

Kriszan *et al* - Effect of volatile compounds in grass silage on voluntary intake

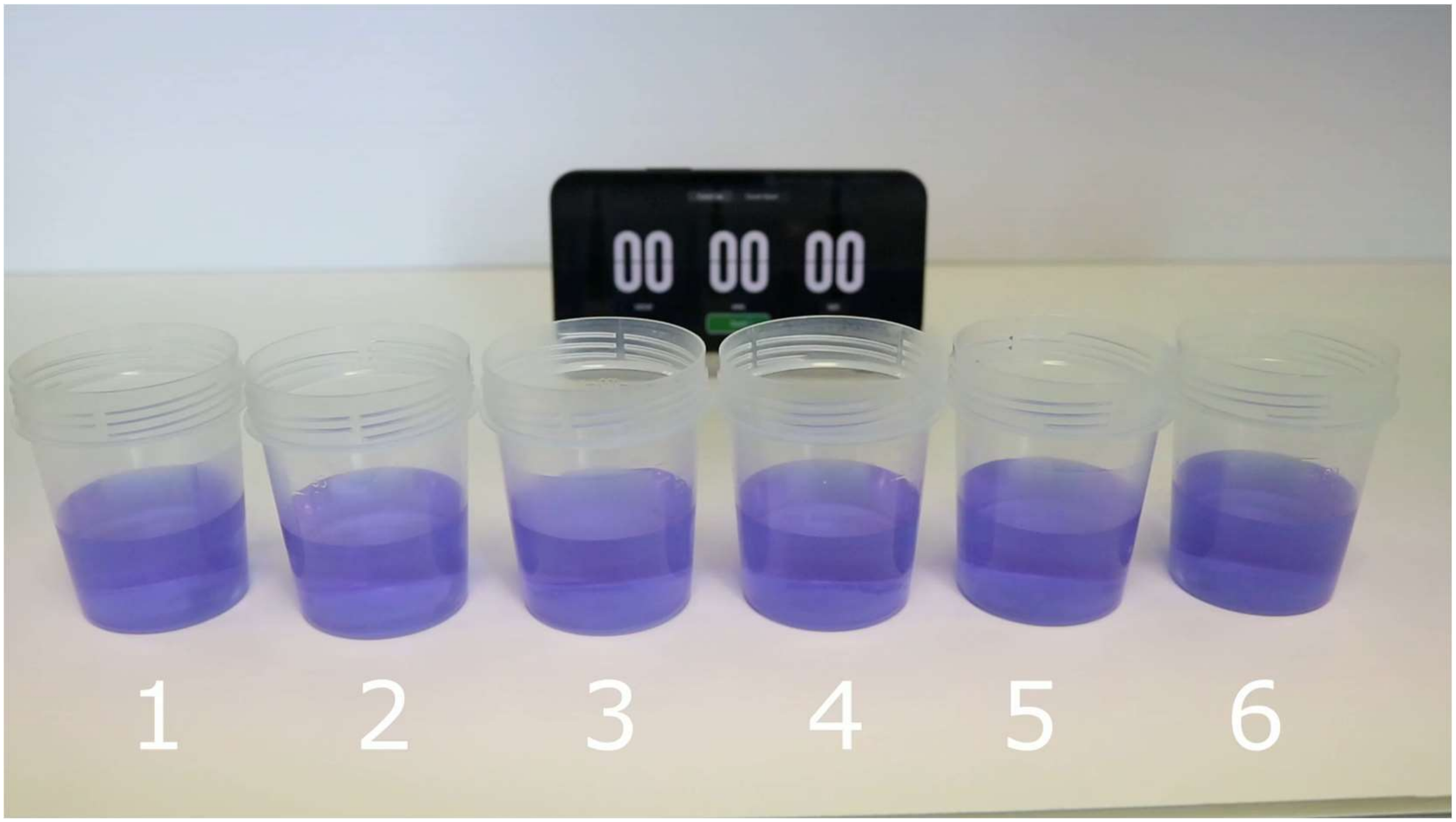
Ecetsav és takarmány-felvétel

- Relationship between dietary content of acetic acid g/Kg DM and DMI (kg/100Kg body weight) in dairy cattle



Open diamonds (◇) acetic acid was added to the ratio; Closed diamonds (◆) silage was inoculated with *L buchneri*

A data analysis on the effect of acetic acid on DM intake in dairy cattle. Gerlach *et al*. Animal Feed Science and Technology, **272,** 2021



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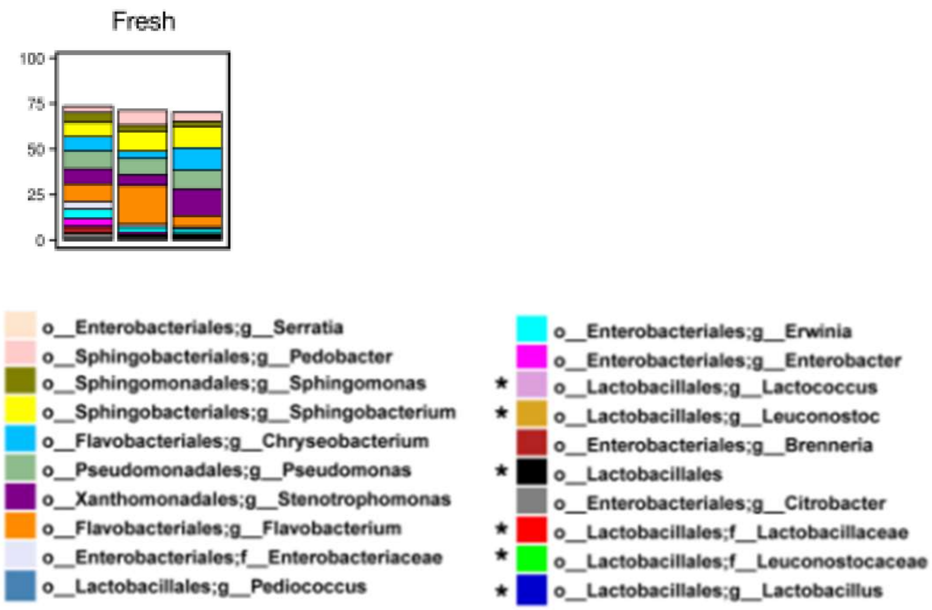
A mikrobiális állapot változása



Drouin, *Microorganisms* **2019**, 7, 595

Evidence of the efficacy of Egalis® Ferment on high-dry-matter grass silage

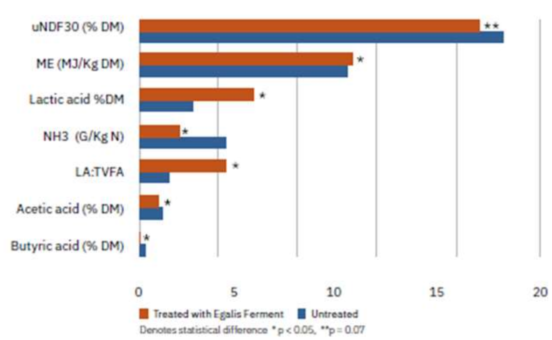
Marley, G.,
Alltech U.K. September 2022

Objective: To assess the impact of Egalis Ferment on the fermentation of second-cut 42.8% dry matter grass silage.

Experimental design: Second-cut Italian ryegrass (*Lolium multiflorum*) was mown with a Kuhn FC313 mower conditioner to an 8-cm cut height, wilted for 30 hours under dry conditions, tedded once, windrowed and commercially collected using a Claas Jaguar 860, and chopped to 2 cm. The nitrate level was recorded at 660 ppm. Five untreated mini silos and five mini silos treated with 1,000,000 cfu/g of Egalis Ferment were produced and stored for 85 days prior to analysis. The grass as ensiled was classed as easy to ensile under EFSA definitions.

Treatments: Control | Egalis Ferment

Post-85-day analysis of grass silage:



Evidence of the efficacy of Egalis® Ferment on high-dry-matter grass silage

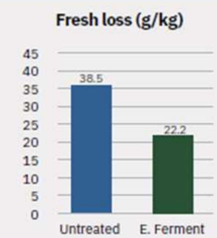
Marley, G.,
Alltech U.K. September 2022

Key observations:

The ash content of the final silage was recorded at 7.7%, indicating no soil contamination.

Treatment with Egalis Ferment was associated with:

- A statistically significant reduction in the final pH and the achievement of a stable pH.
- A statistically significant increase in the lactic acid produced.
- A strong trend (p = 0.07) in uNDF30, which translates to more protected fibre digestibility.
- A statistically significant reduction in the level of butyric acid in the final silage.
- A statistically significant increase in the ratio of lactic acid to undesirable acids and, as a result, a more palatable silage.
- A 50%+ reduction in ammonia, meaning more protein is protected into the final silage.
- A statistically significant reduction (of 42%) in fresh matter losses during the storage period.
- The protection of significantly more energy into the final silage.
- More palatable silage thanks to reduced levels of ammonia and acetic and butyric acids.



A statistically significant reduction (of 42%) in fresh matter losses during the storage period.

Conclusion:
This study demonstrates that under normal ensiling conditions with high levels of sugar, Egalis Ferment significantly enhances fermentation, delivering the benefits associated with statistically enhanced dry matter recovery, feed value and more palatable silage to the animal.

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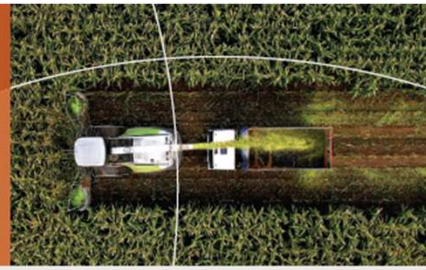
Evidence of the efficacy of Egalis® Rapid on ensiled maize

Marley, G.,
Alltech U.K., January 2023

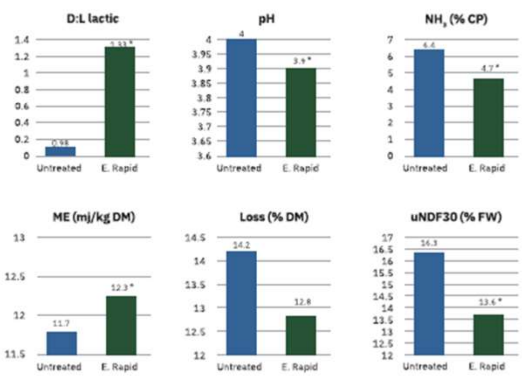


Objective: To assess the impact of Egalis® Rapid on the fermentation, nutritional characteristics and losses of ensiled corn.

Experimental design: Drought-stressed maize (*Zea mays*) was commercially harvested, untreated, using a Krone Big X at a cut height of 15 cm and a theoretical chop length of 12 mm at a dry matter of 33%. Twenty kilograms was homogenised by hand and split into equal aliquots, with Egalis Rapid (Pediococcus pentosaceus and Lacticaseibacillus rhamnosus at 200,000 cfu/g) being applied via hand sprayer at a liquid application rate of 10 ml/kg. Both untreated and treated maize were ensiled in Weck jars (with six replicates per treatment) as per Honig protocol and were subjected to air stress for a 24-hour period at 28 and 42 days post-ensiling. Upon opening, the silage was analysed using a nutritional and fermentation analysis through near infra-red spectroscopy (NIR), and an enzymatic test method was used to differentiate between L- and D-lactic acids.

Treatments: Control | Egalis Rapid

Post-90-day analysis of maize silage



* denotes statistical significance at p = 0.05

Evidence of the efficacy of Egalis® Rapid on ensiled maize

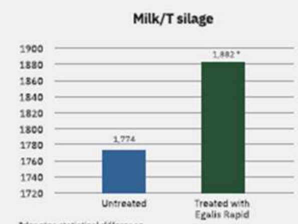
Marley, G.,
Alltech U.K., January 2023

Key observations:

The untreated and treated maize both produced good fermentations; however, there were significant tangible benefits associated with treatment with Egalis Rapid.

Treatment with Egalis Rapid was correlated with:

- A statistically significant shift in the fermentation profile of the lactic acid being produced, leading to an increase in the level of L-lactic acid and a relative decrease in the level of D-lactic acid (L-lactic acid is three times more rapidly adsorbed in the rumen than D-lactic acid).
- A statistically significantly lower final pH compared to the pH of the untreated silage, which reduced the proteolysis in the silage (i.e., a lower level of ammonia in the final silage).
- Statistically significantly more energy being maintained from the field into the final silage (i.e., a higher level of metabolizable energy in the final silage).
- A statistically significant reduction in fermentation losses, protecting more silage from the field to the feed-out passage.
- A statistically significant reduction in the undigestible neutral-detergent fibre in the final silage, meaning more fibre digestibility can be maintained into the rumen.



*denotes statistical difference

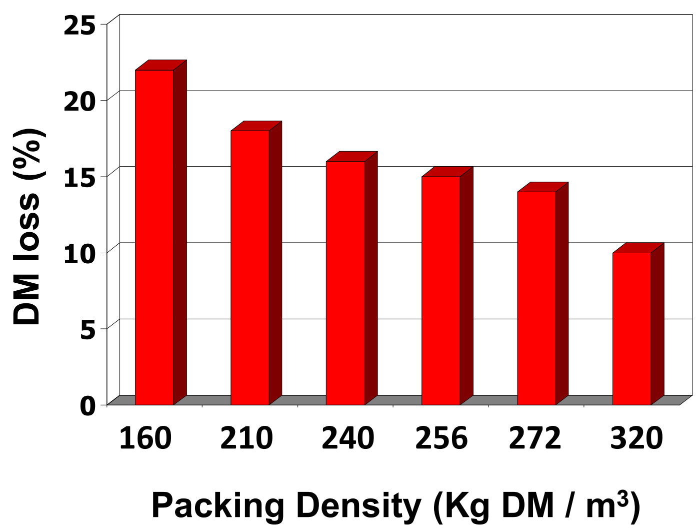
A statistically significant increase in the projected milk production from the Egalis Rapid-treated silage, with a projected 6% increase in milk production.

Conclusion:

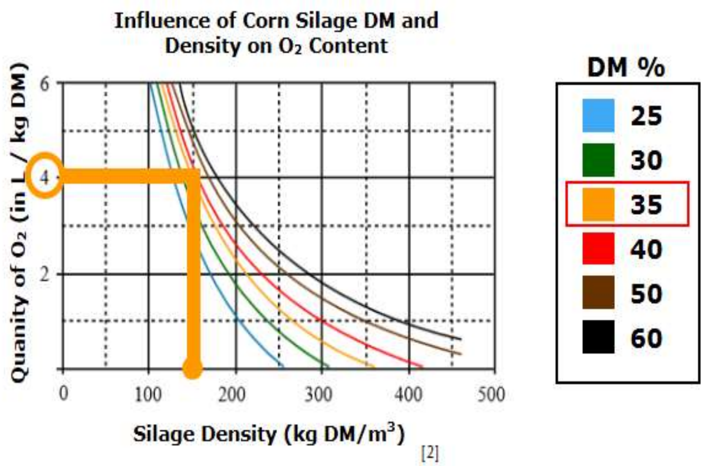
This study demonstrates that Egalis Rapid can help enhance the fermentation of maize silage, better protecting the feed value of the silage from the field to the feed passage.

Tömörítés

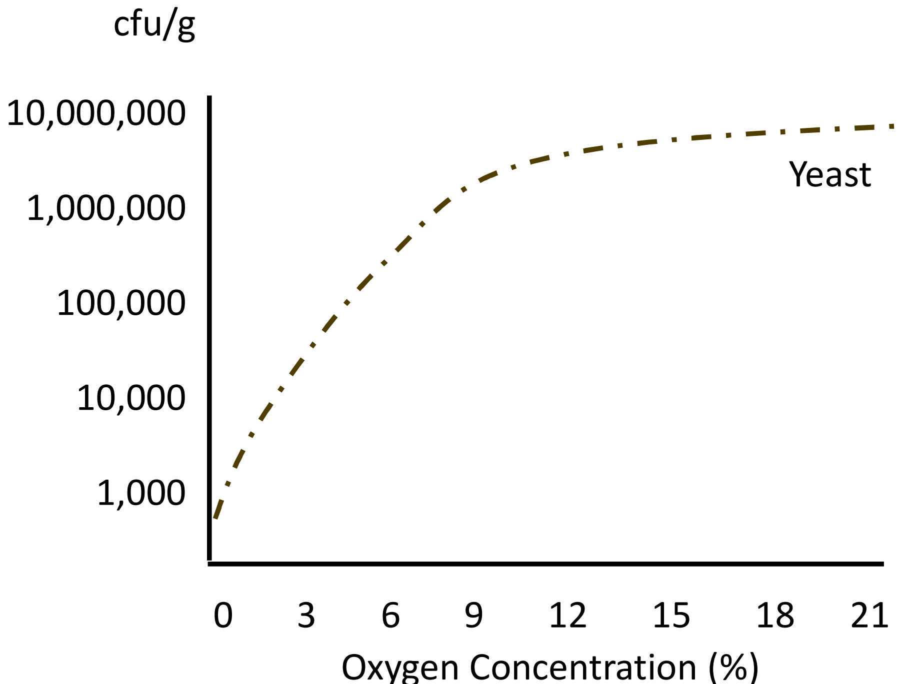
Tömörítés – Tömörség - Légrések



(Adapted Ruppel, 1992)



2024 Információ – jelenlegi és aktuális



Adapted: Williams

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Higiénia

Betakarításkor és silózáskor

Talaj és fermentáció

- Grass +/- soil contamination

Contamination	No Soil		Soil		Contamination
Additive	CONT	LAB	CONT	LAB	Additive
Dry matter (DM), g/kg	332^{ab}	344^{ab}	341^{ab}	339^{ab}	Dry matter (DM), g/kg
pH	5.53^{b}	4.00^{f}	4.26^{d}	4.01^{f}	pH
Ammonia N, g/kg N	59^{a}	21^{c}	43^{b}	22^{c}	Ammonia N, g/kg N
Ash	86^{ab}	85^{abcd}	86^{ab}	84^{bcd}	Ash
Crude protein	172^{abc}	171^{abc}	170^{abc}	170^{abc}	Crude protein
Water soluble carbohydrates	120^{bc}	76^{d}	5^{e}	66^{d}	Water soluble carbohydrates
Ethanol	16.5^{c}	3.2^{e}	16.4^{c}	3.9^{e}	Ethanol
Silage DM intake index (2007)	120.5^{a}	109.8^{d}	110.9^{bc}	109.8^{d}	Silage DM intake index (2007)
Formic	0	0	0	0	Formic
Lactic (LA)	21.8^{c}	114.5^{a}	86.2^{b}	115.5^{a}	Lactic (LA)
Acetic	8.3^{bc}	12.0^{bc}	30.4^{a}	9.4^{bc}	Acetic
Propionic	0.17^{c}	0.10^{c}	0.24^{c}	0.11^{c}	Propionic
Propionic [3]	0.17	0.10	0.24	0.11	Propionic [3]
Butyric	0.29	0.05	0.03	0.03	Butyric
Total volatile fatty acids (VFA)	8.76^{bc}	12.12^{bc}	30.76^{a}	9.55^{bc}	Total volatile fatty acids (VFA)
Total fermentation acids [4]	30.5^{c}	126.6^{a}	116.9^{b}	125.0^{a}	Total fermentation acids [4]
LA/total fermentation acids	0.71^{bc}	0.91^{a}	0.74^{bc}	0.92^{a}	LA/total fermentation acids
Total fermentation products [5]	47^{b}	130^{a}	133^{a}	129^{a}	Total fermentation products [5]
Aerobic stability (2 °C), hours [6]	73^{bcd}	133^{b}	469^{a}	90^{bcd}	Aerobic stability (2 °C), hours [6]
Ensiling losses, g/kg of initial DM	79^{b}	17^{f}	44^{e}	41^{e}	Ensiling losses, g/kg of initial DM
Yeasts, cfu/g	1.4×10^4	3.0×10^2	1.0×10^2	4.0×10^4	Yeasts, cfu/g
Molds, cfu/g	$5.2 \times 10^{3\,b}$	$3.1 \times 10^{2\,b}$	$1.0 \times 10^{2\,b}$	$4.6 \times 10^{2\,b}$	Molds, cfu/g
Clostridia, spores/g	42	3	3	3	Clostridia, spores/g
Zearalenone, ppb	234	na	1598	na	Zearalenone, ppb
Deoxynivalenol, ppb	322	na	558	na	Deoxynivalenol, ppb

Fermentation quality and bacterial ecology of grass silage modulated by additive treatment, extent of compaction and soil contamination, Franco et al, Fermentation, 2022 (adapted to show only tight compaction)

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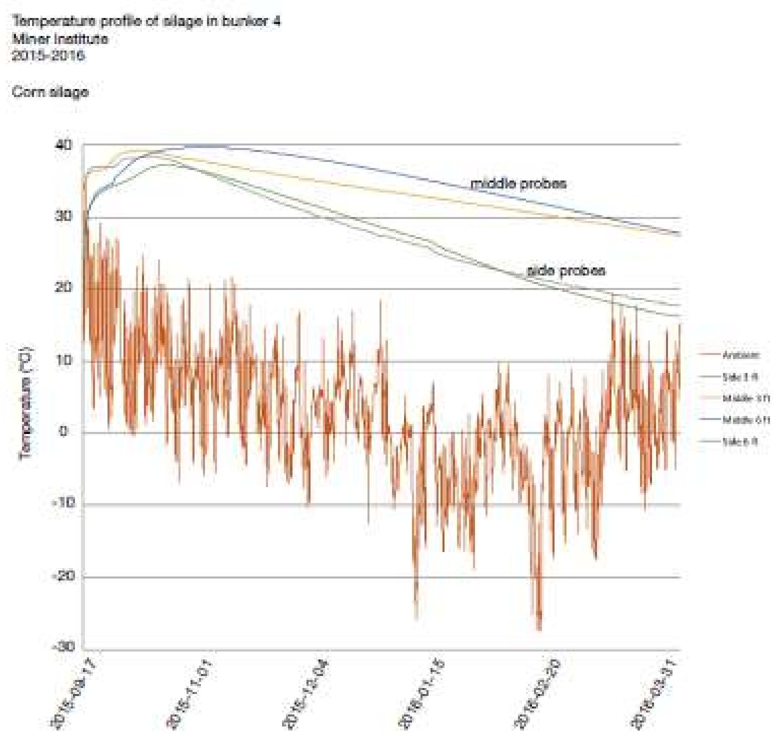
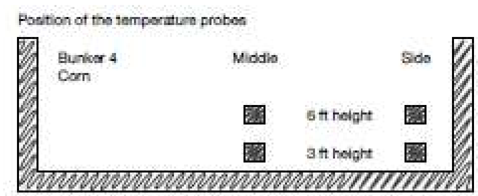
Silózáskori hőmérséklet

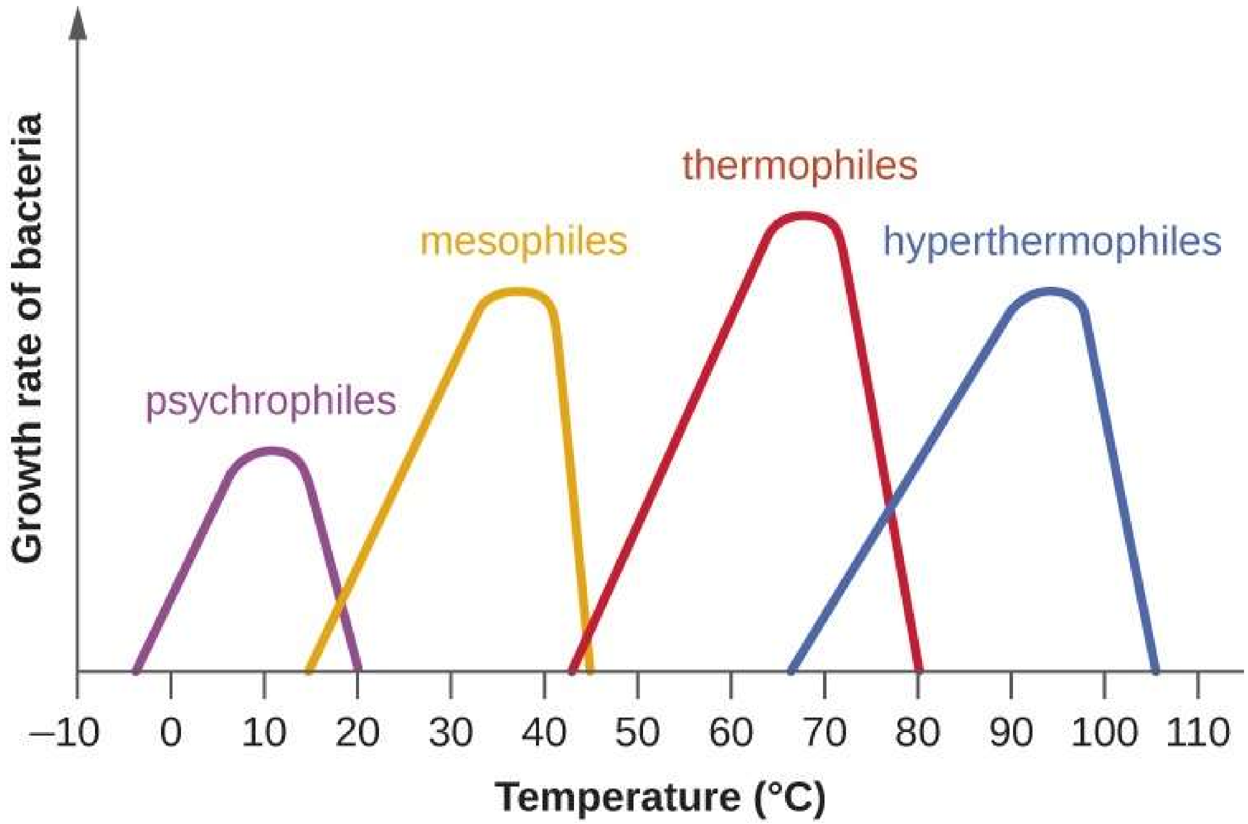
Silózáskori hőmérséklet



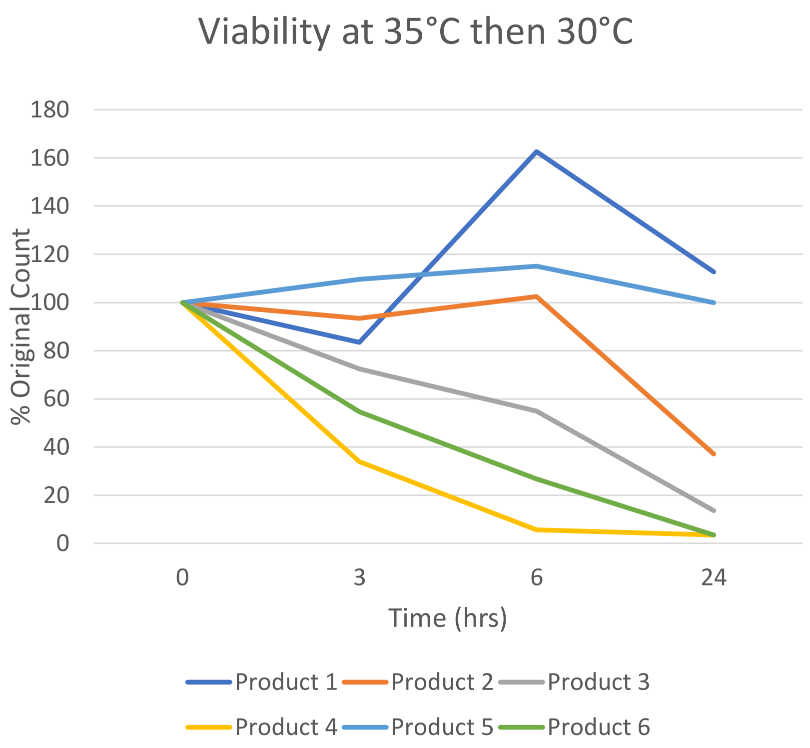


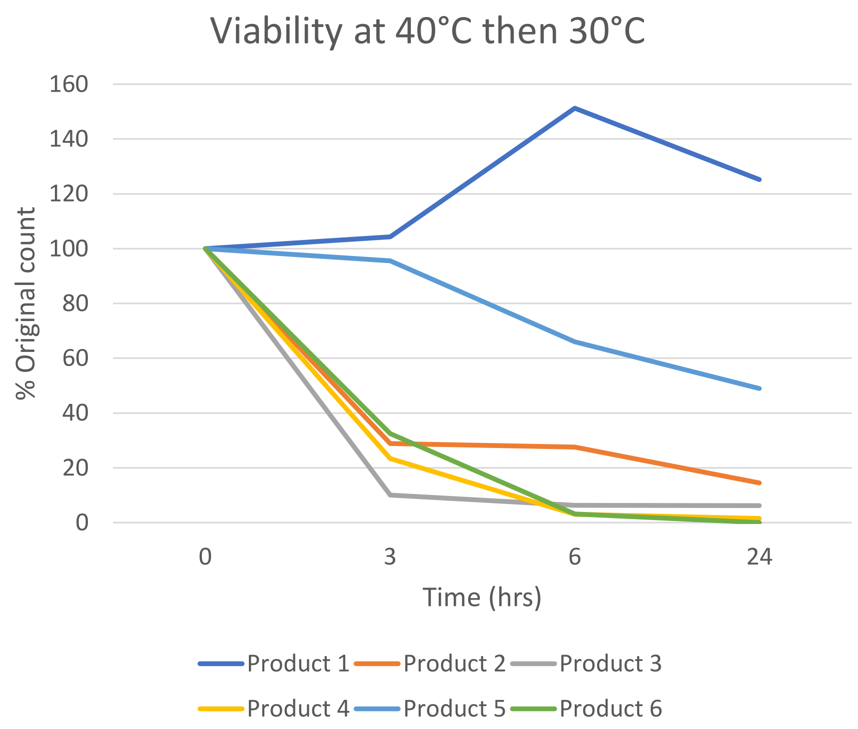
Pascal Drouin, Miner Institute, Corn silage 2016

Baktériumok szaporodása



Adalékok aktivitása hőmérséklet függvényében





Mulrooney & Kung, JDS, 2008

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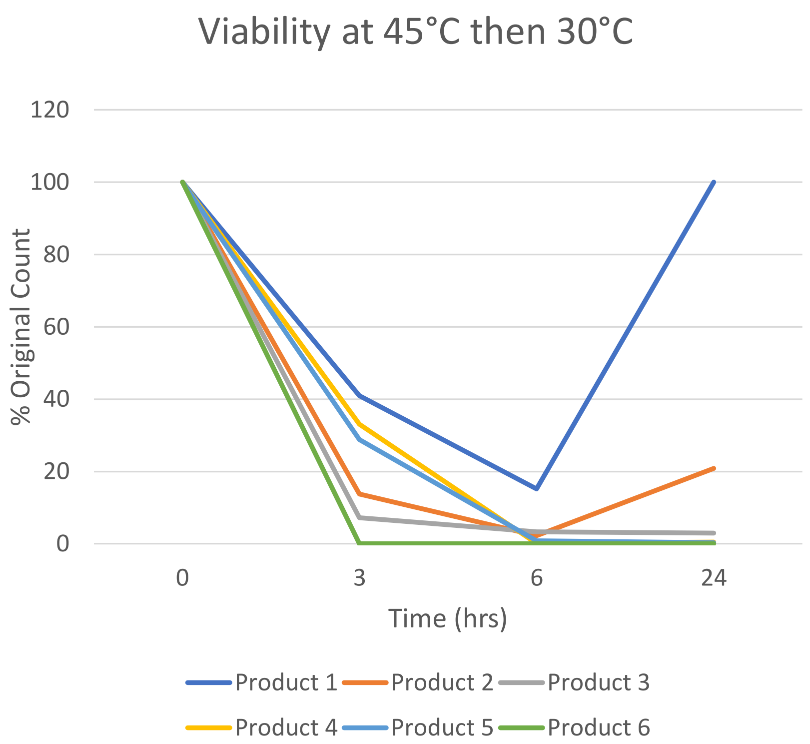
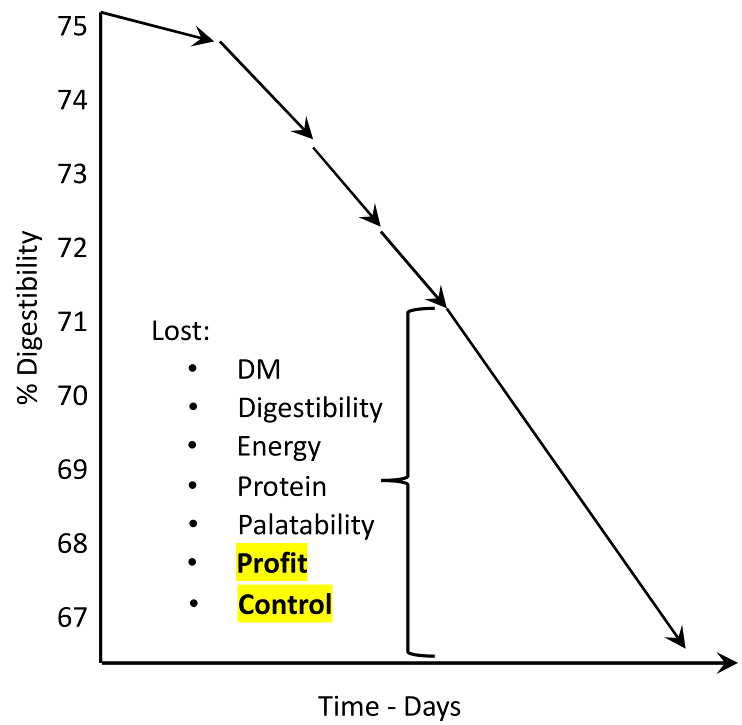
Adalékok aktivitása hőmérséklet függvényében



Mulrooney & Kung, JDS, 2008

Betakarítási idő

Betakarítás sebessége



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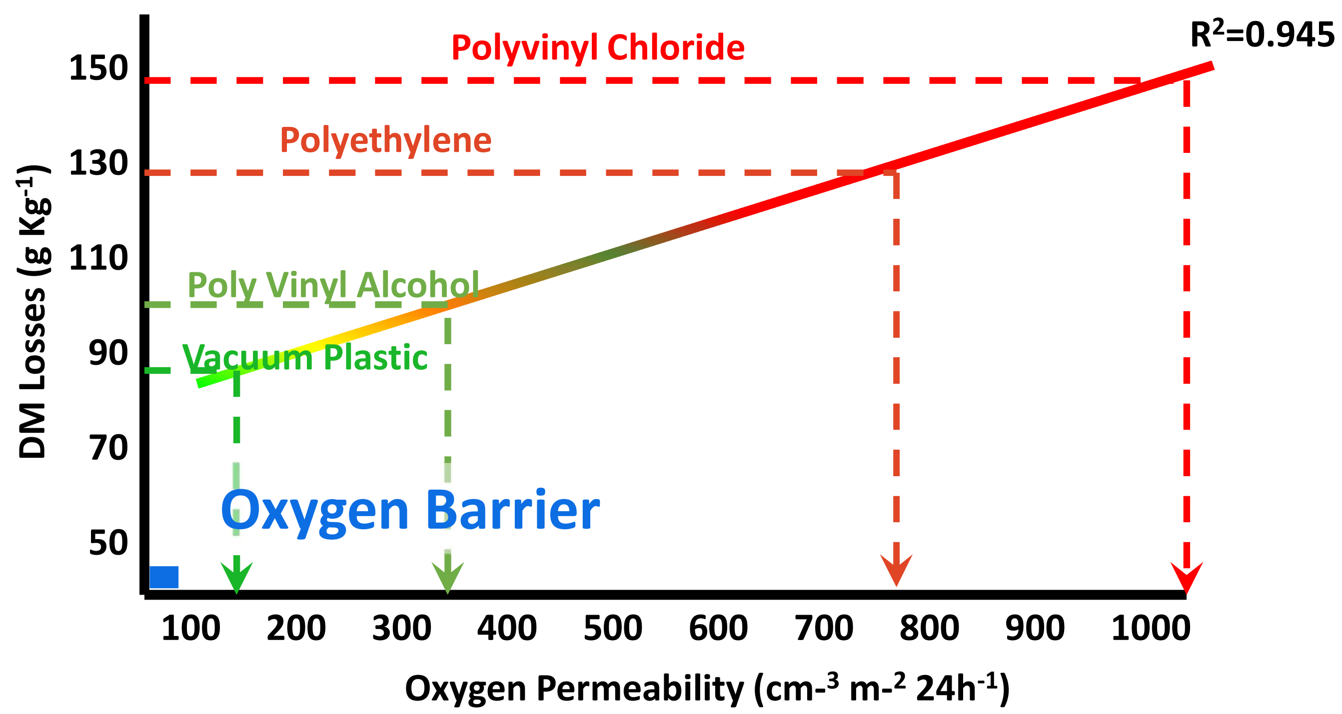
Betakarítási idő

- és fedés

Takarás

Oxigén áteresztés mértéke



Adapted from Bernardes, 2011

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A fólia hatása a fermentációra

Table 2. Fermentation quality and microbial composition at unloading of silages sealed with oxygen barrier (OB) and standard polyethylene (PE) films after 110 days of conservation (Table view)

Parameter[a]	Value for:		SE	*P* value
	PE	OB		
pH	3.78	3.73	0.011	0.002
DM (g kg^{-1})	297	310	8.22	0.500
Lactic acid (g kg^{-1} DM)	45.3	53.2	2.08	0.033
Acetic acid (g kg^{-1} DM)	27.6	22.7	1.23	0.019
Butyric acid (g kg^{-1} DM)	<0.10	<0.10		
Propionic acid (g kg^{-1} DM)	0.45	0.76	0.164	0.402
1,2-Propanediol (g kg^{-1} DM)	10.5	10.4	0.706	0.981
Ethanol (g kg^{-1} DM)	12.3	11.2	0.651	0.443
Lactic-to-acetic acid ratio	1.64	2.34	0.165	0.004
Nitrate (mg kg^{-1} silage)	837	1026	156	0.603
NH_3-N (g kg^{-1} TN)	46.8	45.8	0.112	0.746
Ash (g kg^{-1} DM)	40.6	40.2	0.031	0.656
a_w	0.99	0.99	0.001	0.947
Yeasts ($\log_{10}$ CFU g^{-1} silage)	3.12	1.17	0.443	<0.001
Molds ($\log_{10}$ CFU g^{-1} silage)	1.74	1.41	0.118	0.189
Aerobic spores ($\log_{10}$ CFU g^{-1} silage)	2.65	2.97	0.095	0.095
Weight loss (g kg^{-1} DM)	37.5	30.6	0.178	0.035
Aerobic stability (h)	65	152	19.9	0.001

a a_w, water activity; C, control treatment; DM, dry matter; LAB, lactic acid bacteria; NH_3-N, ammonia nitrogen; TN, total nitrogen.

Bernardes 2011

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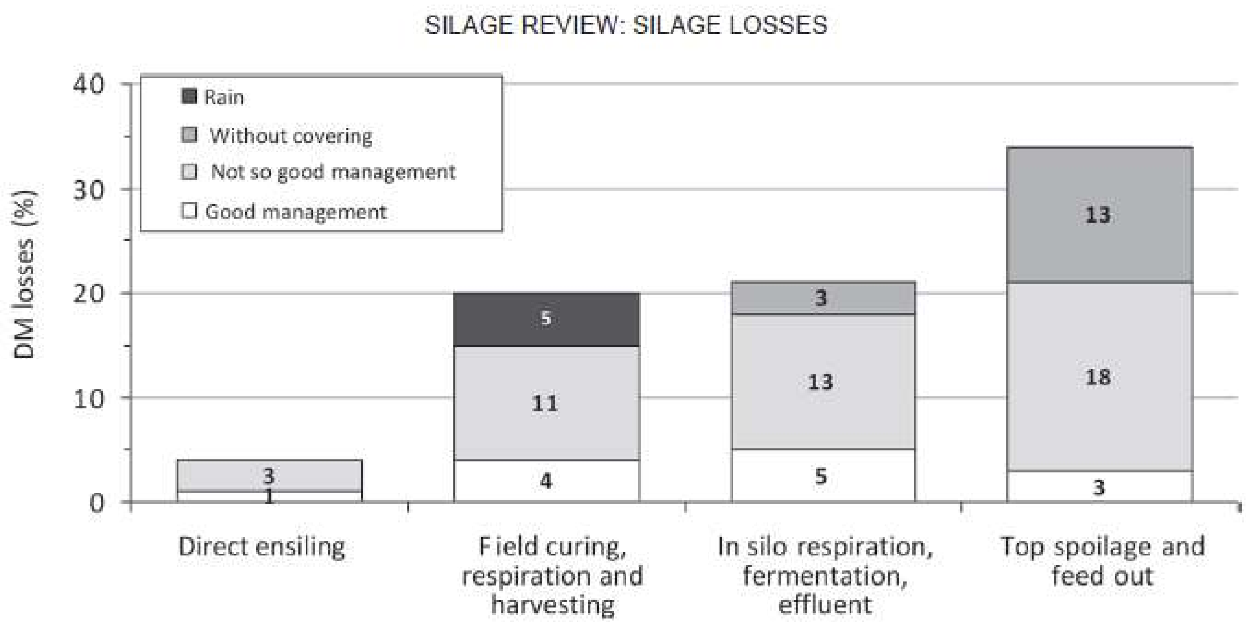
Tárolási management

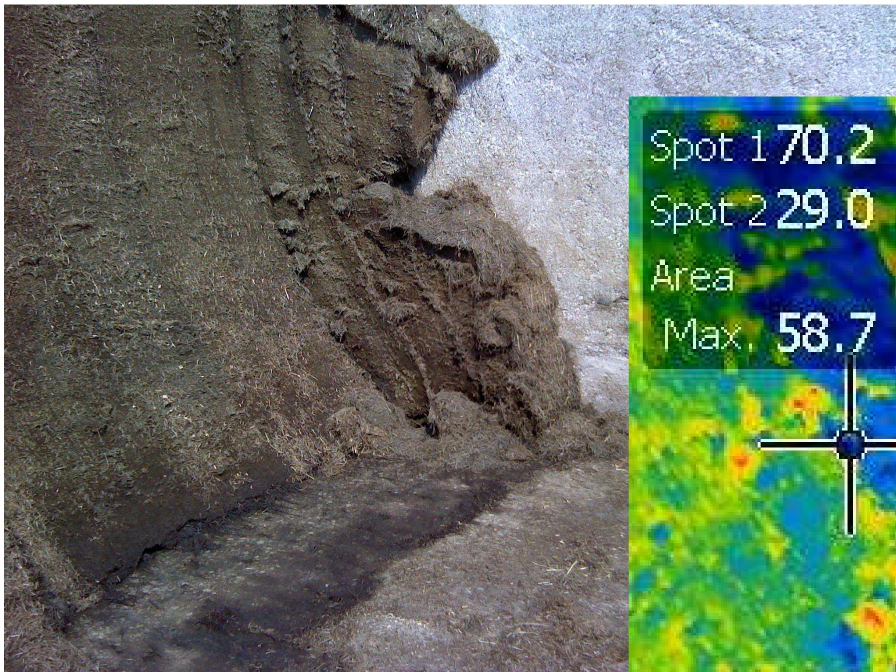
Management

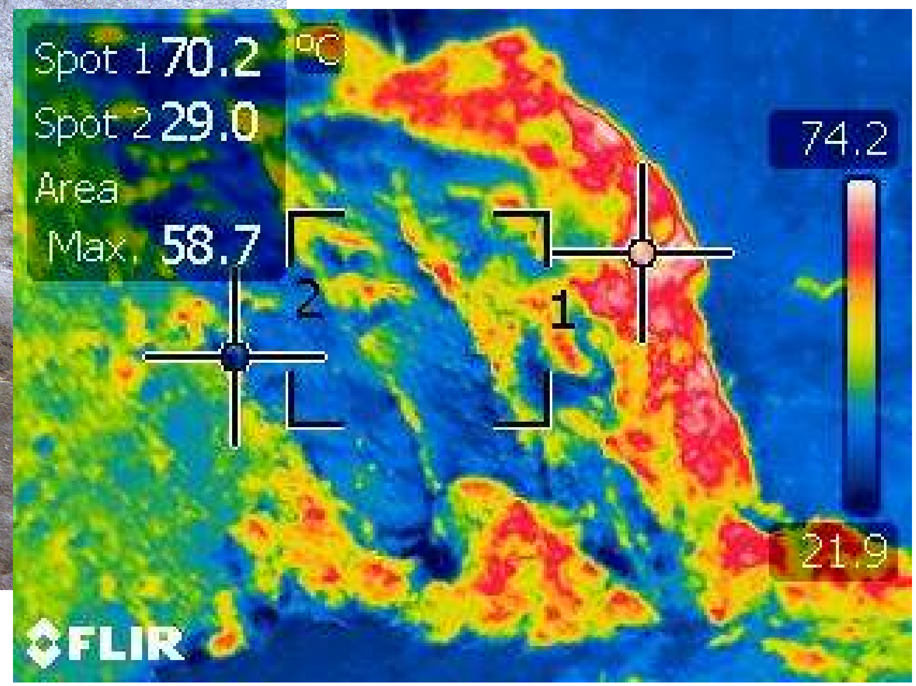


Borreani et al, JDS, 2017

Kitárolási management

Kitárolási management





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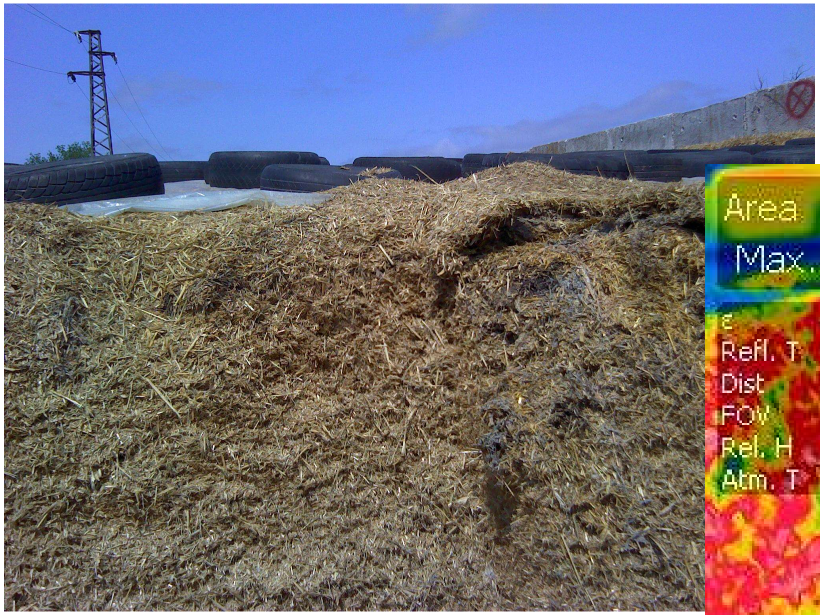
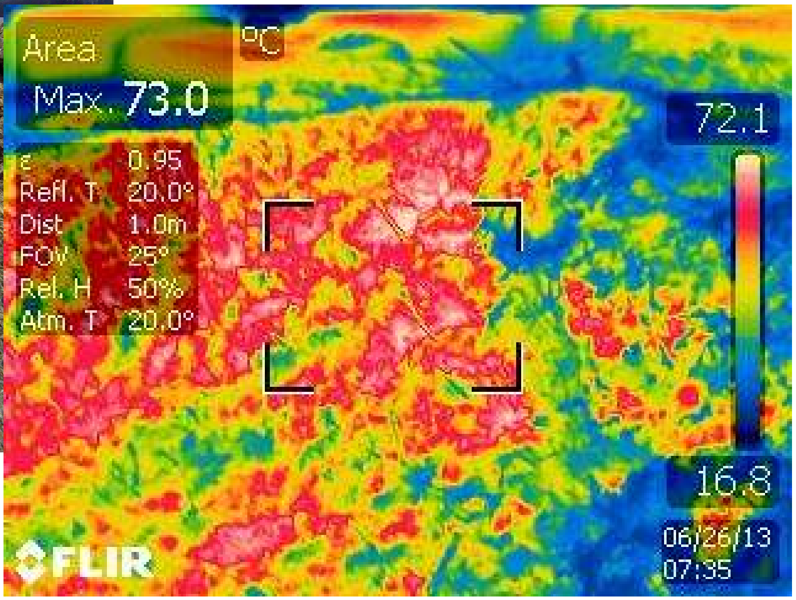
Kitárolási management





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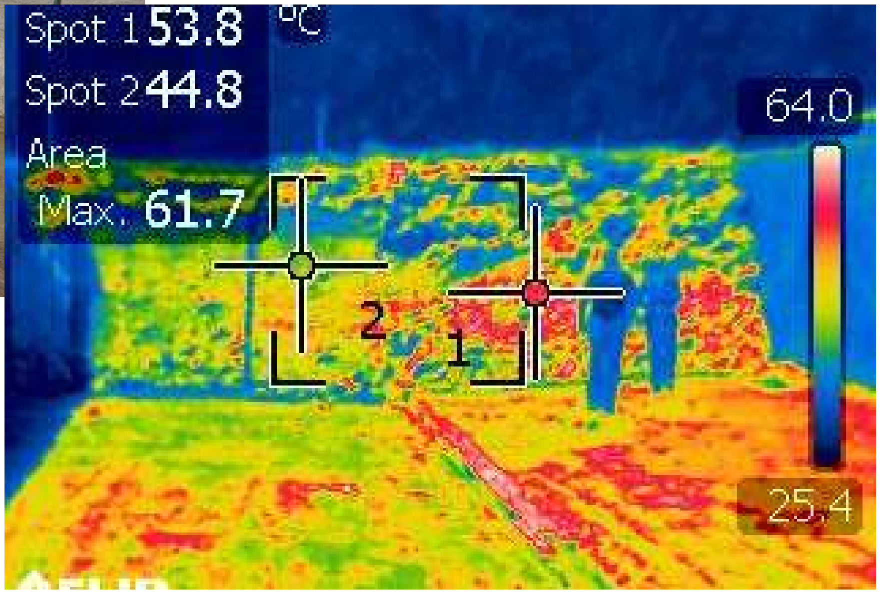
Kitárolási management

Kitárolási management



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A szilázsminőséget befolyásoló tényezők

- **<u>Időzítés (fenofázis)</u>**
- Szárazanyag tartalom
- Szecskahossz
- Adalékanyag
- Tömörítés
- Higiénia a betakarítás és besilózás során

- Silózáskori hőmérséklet
- Betakarítási idő
- Takarás
- Tárolási management
- Kitárolási management

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Köszönöm…
Kérdések?

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Kérődző Workshop

2024. február 21., szerda
Székesfehérvár