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Practically improving the feeding value of your maize silage for livestock and AD

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Outline

- Feeding value: How to predict
- Feeding value of maize products
- Effect of
  - Maturity
  - Ensiling
  - Delayed sealing
  - Aerobic exposure after ensiling
  - Processing
- Summary

Feeding value: How to predict

In Germany, the following equation is recommended for the prediction of metabolizable energy (ME) in maize products (GfE, 2008)

ME (MJ/kg dry matter (DM)) =

7.15

+ 0.00580 Enzyme soluble organic matter (**ESOM**)

- 0.00283 Neutral detergent fibre (**aNDFom**)

+ 0.03522 Crude fat (**CL**)

ESOM, aNDFom, and CL are in g/kg DM

Feeding value of maize silages

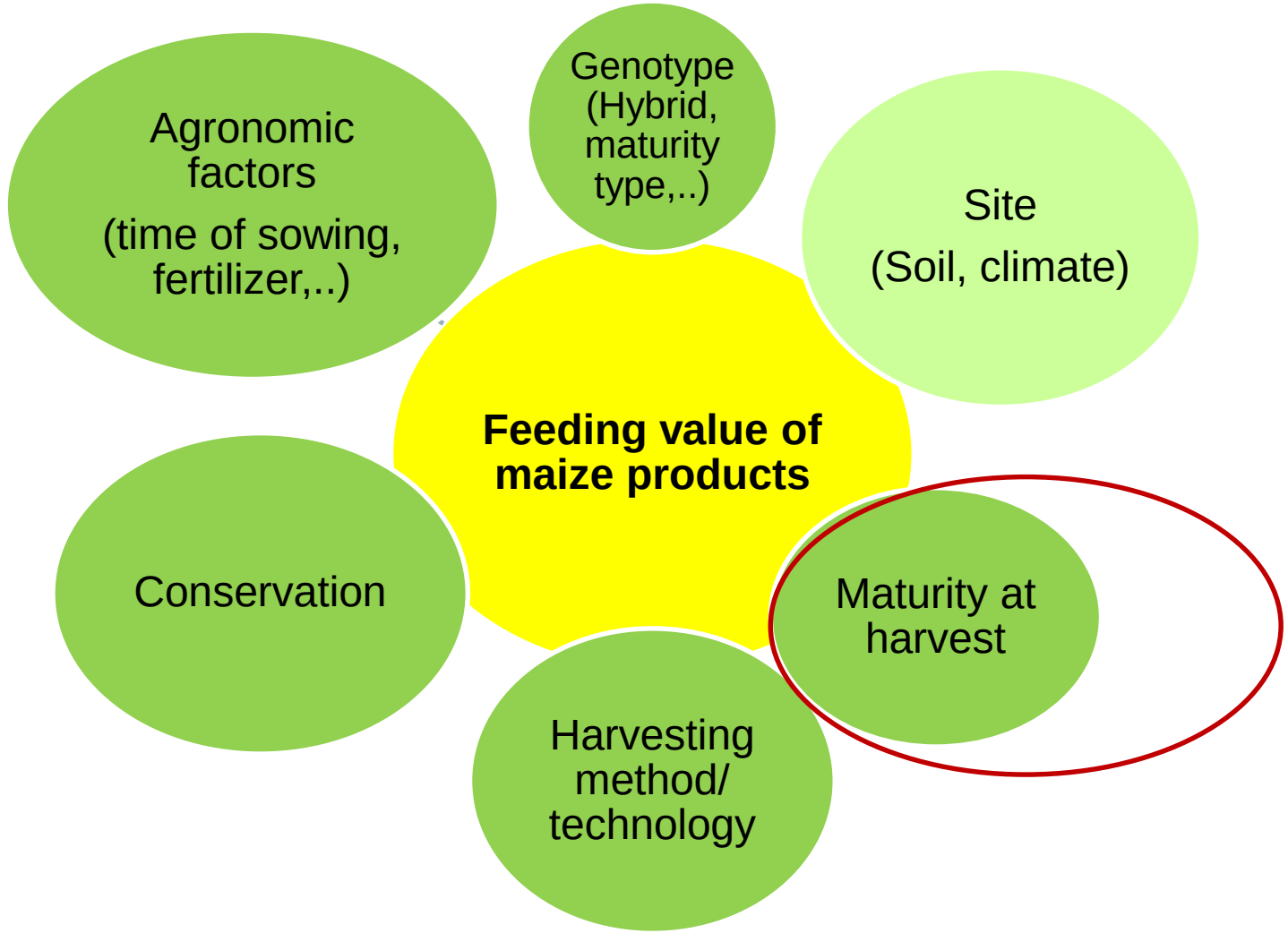
Chemical composition and feeding value of maize silages in North-Rhine-Westphalia, **harvest 2016** (g/kg DM)

	Mean n = 719	**Orientation value**	**Min**	**Max**
Dry matter (g/kg)	372	**280-350**	211	546
Crude protein	72	**<90**	51	104
Crude fat			14	44
aNDFom			309	584
Starch	326	**>300**	150	436
ESOM	686	**>670**	600	780
ME (MJ/kg DM)	11.1	**>11.0**	9.8	12.1
NEL (MJ/kg DM)	6.7	**>6.5**	5.7	7.5

Main cause for variation?

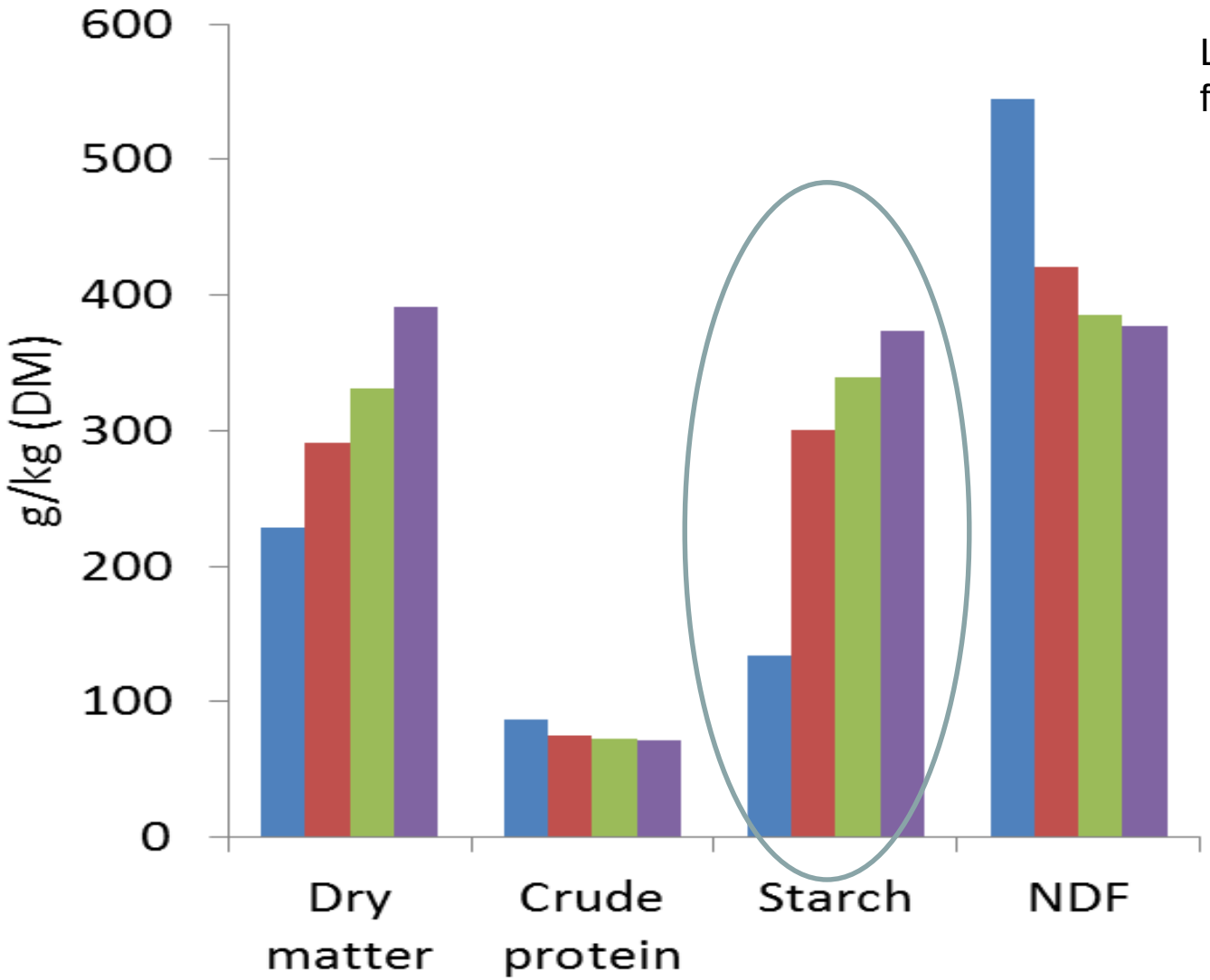
LUFA NRW (2016)

Feeding value of maize products



Schwarz (2014) modified

Effect of harvest maturity on chemical composition of maize silages

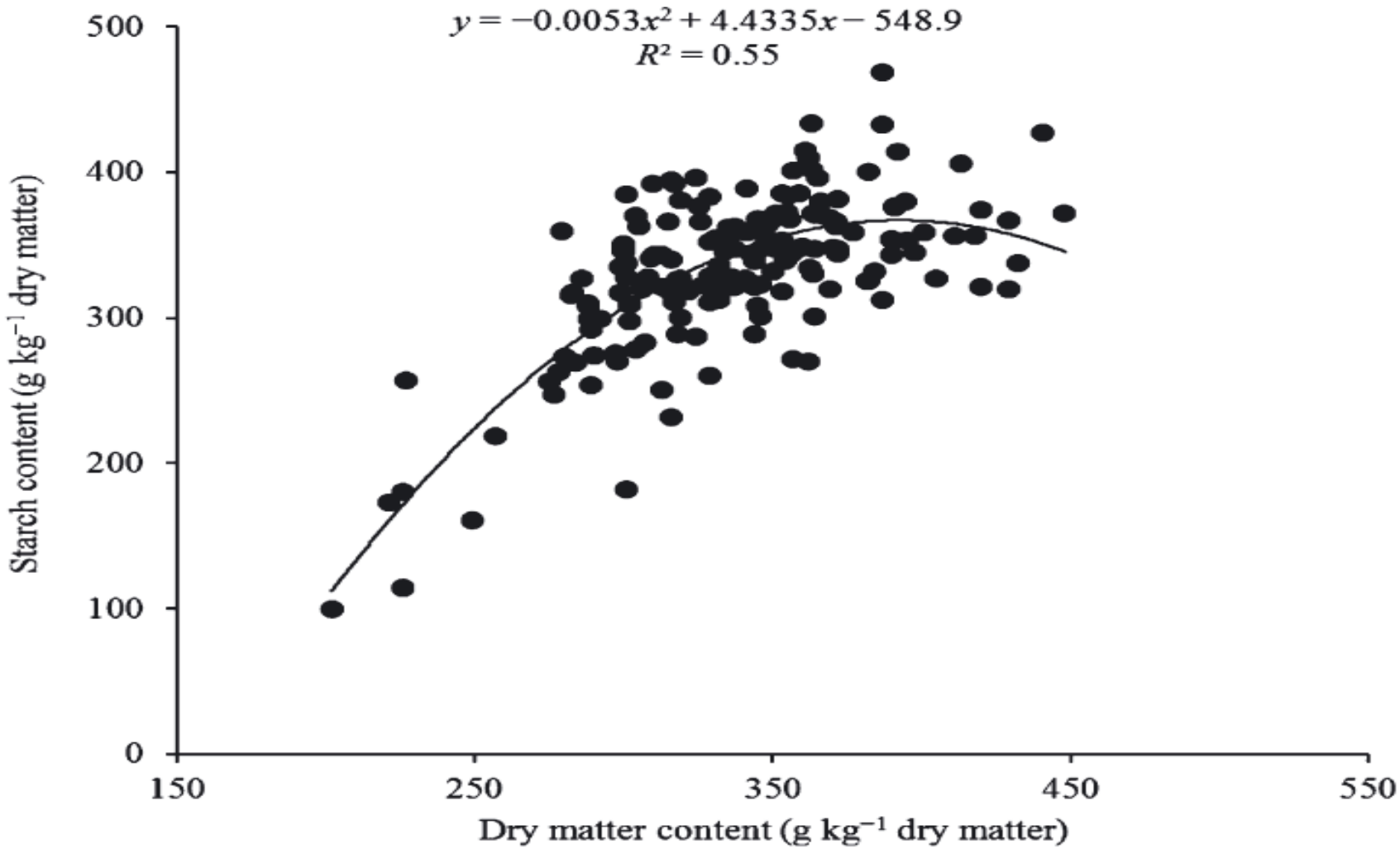


Literature review, number of observations > 200 for each variable

- Very wet (DM <250 g/kg)
- Wet (DM 250-290 g/kg)
- Normal (DM 300-350 g/kg)
- Dry (DM >350 g/kg)

Khan et al. (2015)

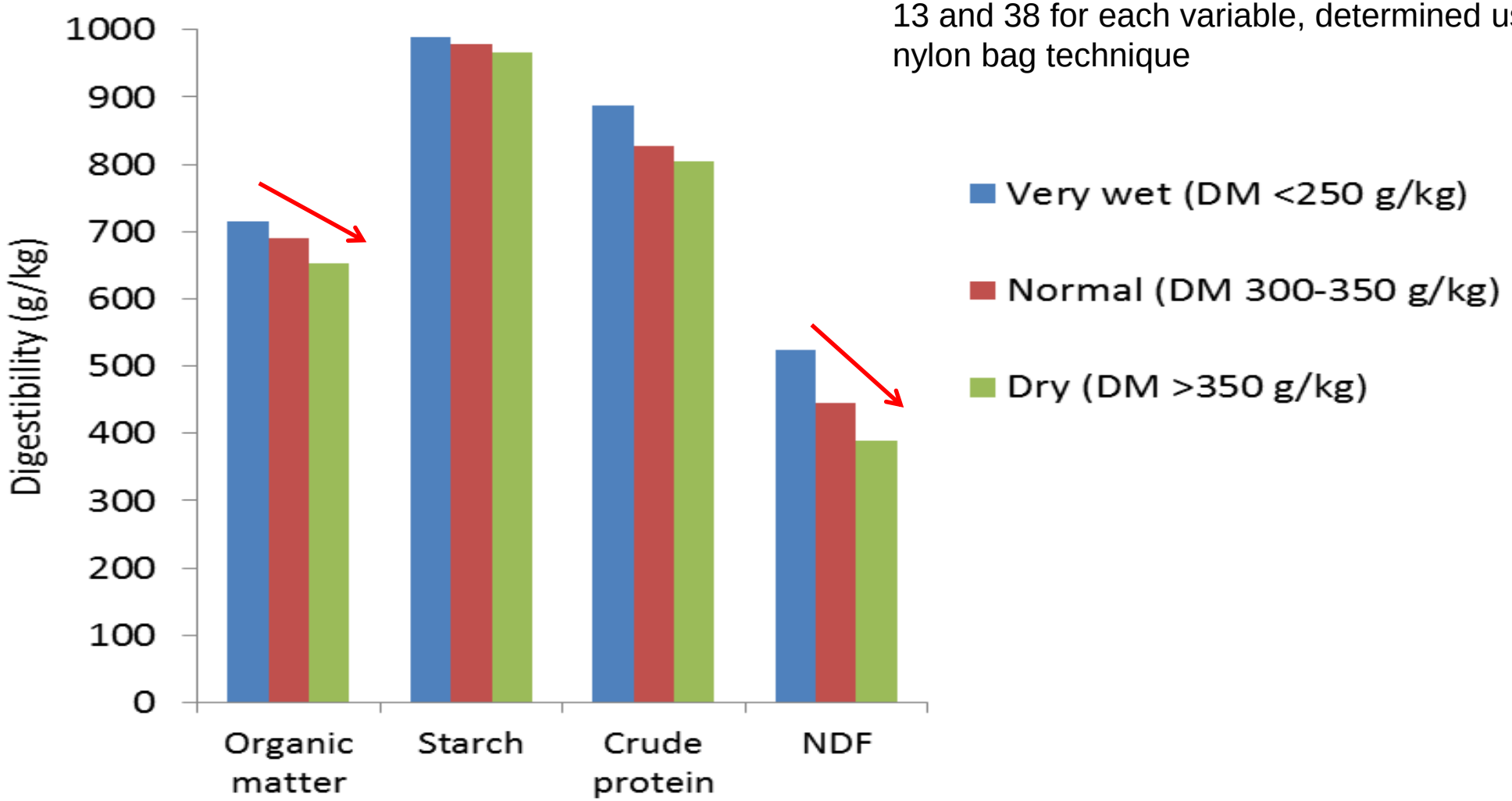
Effect of harvest maturity on starch content of maize silages



Khan et al. (2015)

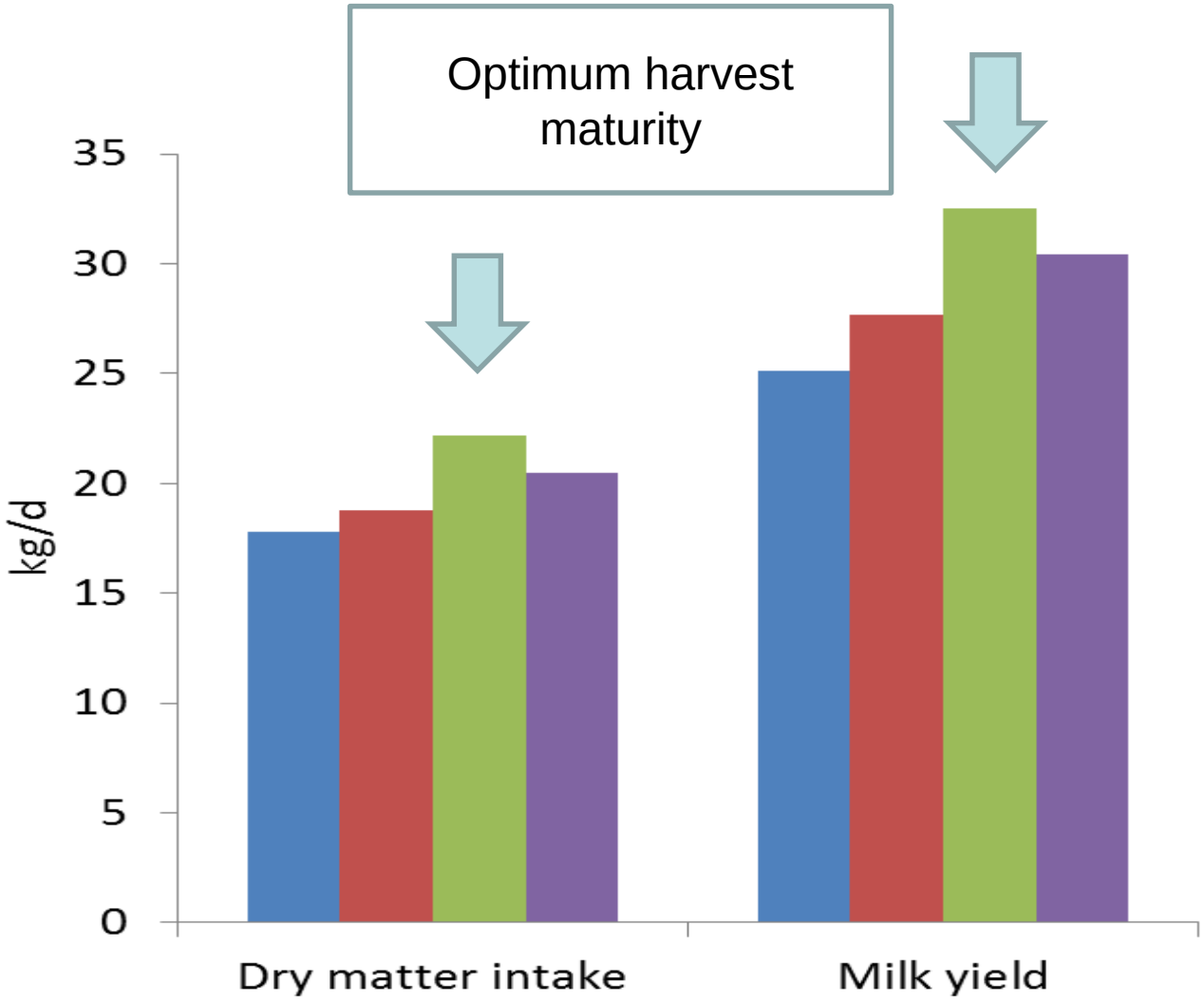
Effect of harvest maturity on nutrient digestibility of maize silages

Literature review, number of observations between 13 and 38 for each variable, determined using nylon bag technique



Khan et al. (2015)

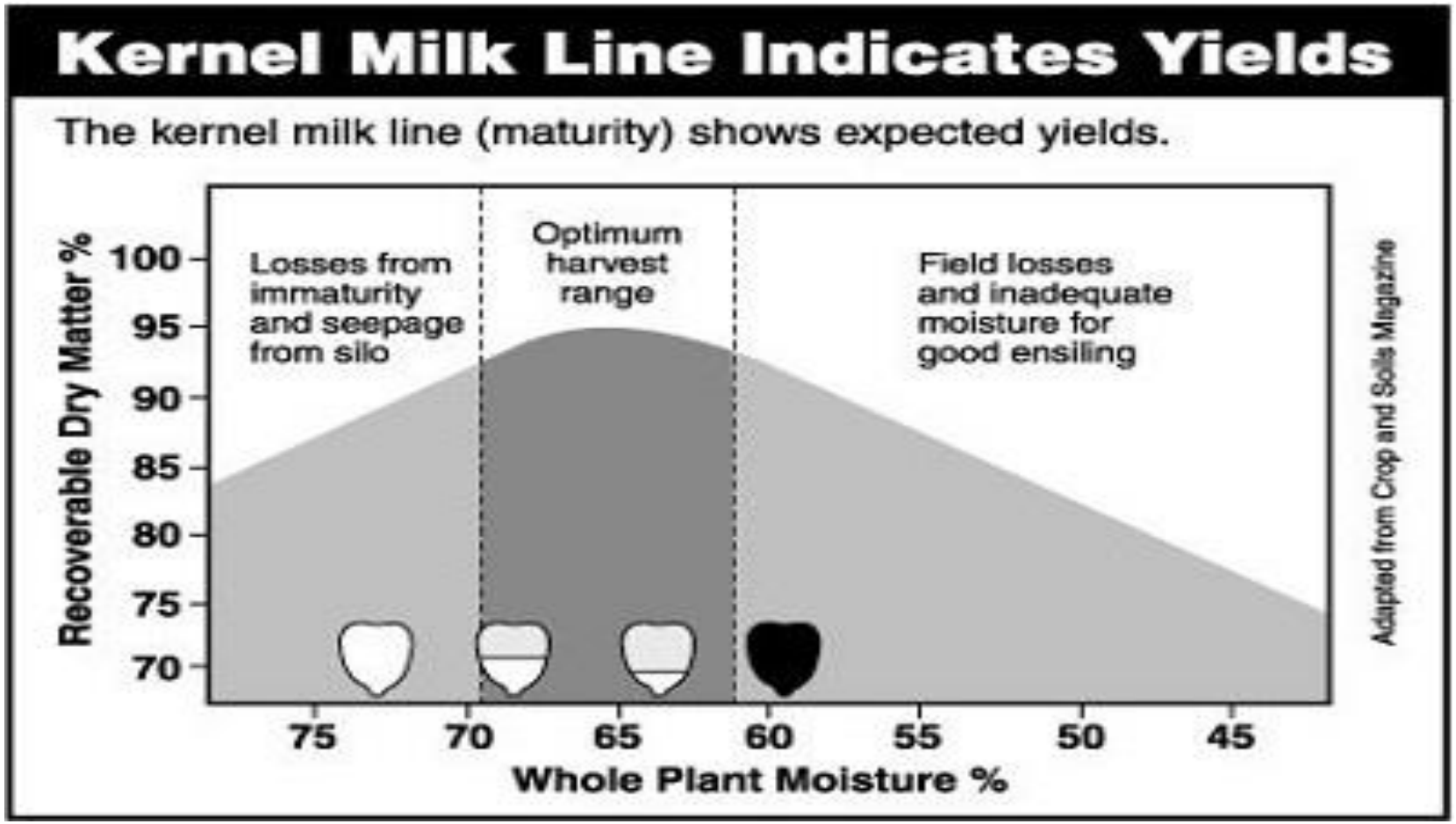
Effect of harvest maturity of maize silages on feed intake and milk yield by dairy cows



Literature review, number of observations = 51

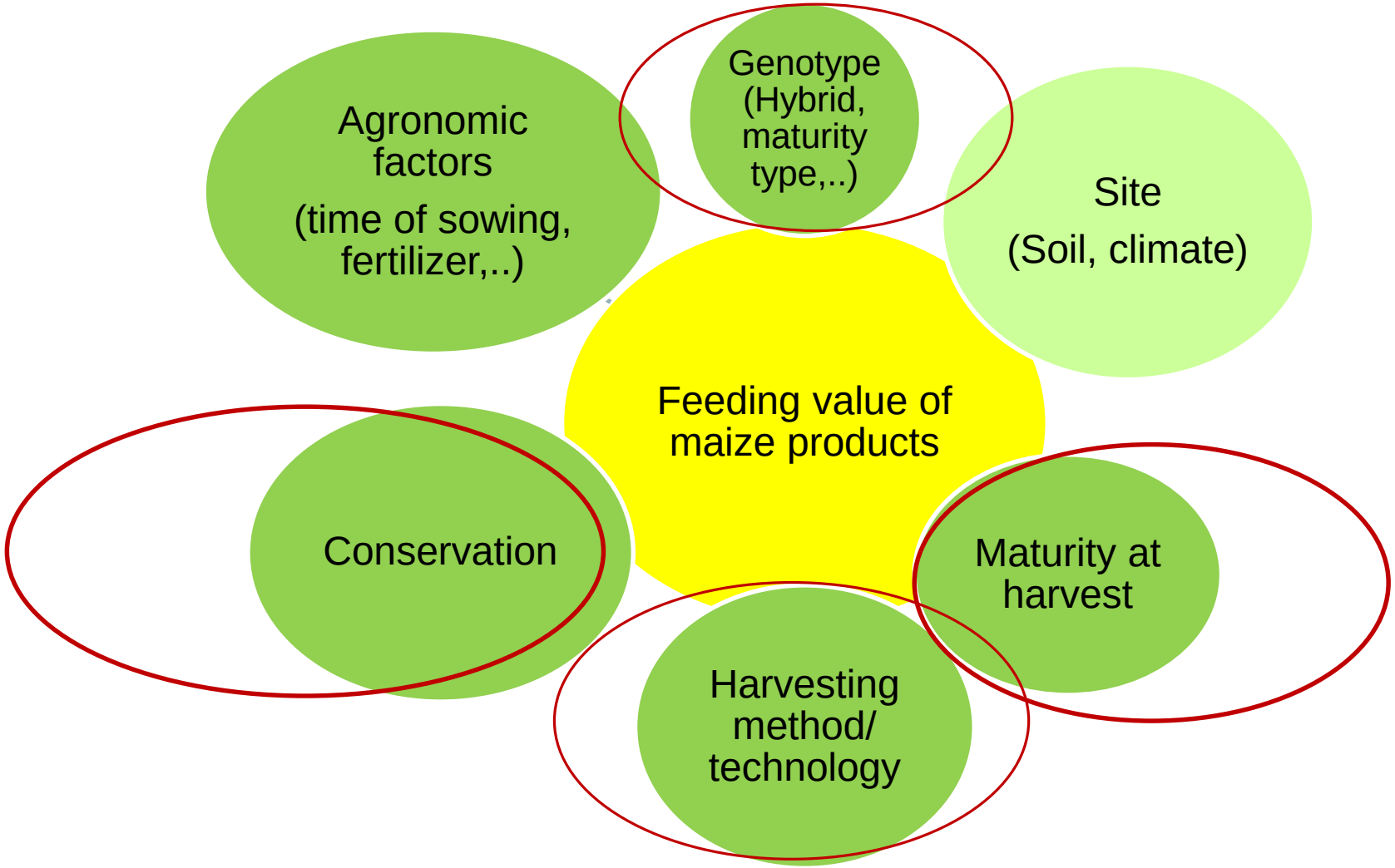
Khan et al. (2015)

Optimize harvest date for silage maize



Feedipedia.org

Feeding value of maize products



Schwarz (2014) modified

What happens during ensiling?

Effect of **ensiling period** on feeding value of maize silages

	Storage length [d]				
	0	30	60	90	120
Dry matter	342	346	346	342	344
Crude protein	73.4^{a}	73.6^{a}	72.9^{a}	72.0^{a}	**65.8^{b}**
aNDFom	**389^{a}**	361^{b}	357^{b}	354^{b}	**349^{b}**
Starch	355	358	358	355	368
ME [MJ/kg DM]	10.6^{b}	10.8^{ab}	10.9^{a}	11.0^{a}	10.9^{a}
***In vitro* gas production [ml/200 mg DM]**	57.2^{b}	58.3^{ab}	58.8^{a}	59.5^{a}	58.8^{a}
ESOM	**681^{b}**	721^{a}	721^{a}	**731^{a}**	723^{a}

aNDFom = Neutral detergent fibre treated with amylase and expressed exclusive residual ash,
ME = Metabolizable energy, ESOM = Enzyme soluble organic matter

Gerlach et al. (2015)

Effects of delayed sealing on DM losses and aerobic stability of maize silages

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	Silage Density					
	Low			High		
Sealing time (d)	**0**	**2**	**4**	**0**	**2**	**4**
DM losses (%)	**3.7[a]**			**5.5[a]**		
Aerobic stability (h)	**64**			**65**		

Delayed sealing → Increased losses + decreased aerobic stability after opening!

Brüning et al. (in press)

Effect of delayed sealing on feeding value of silage maize

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	Silage maize at harvest	Sealing 2 days delayed		Sealing 4 days delayed	
		Low density	High density	Low density	High density
DM (g/kg)	277	290	304	285	298
Starch (g/kg DM)	285	281	279	272	280
GP (ml/200 mg DM)	60.2	58.9	57.8	56.7	58.7
ME (MJ/kg DM)	10.9	10.8	10.6	10.5	10.8
Sugar (WSC, g/kg DM)	160	72.3	72.2	55.9	57.0
Non-protein N (g/kg of N)	103	182	260	279	258
NH_3-N (g/kg N)	9.1	16.0	13.3	18.4	15.2

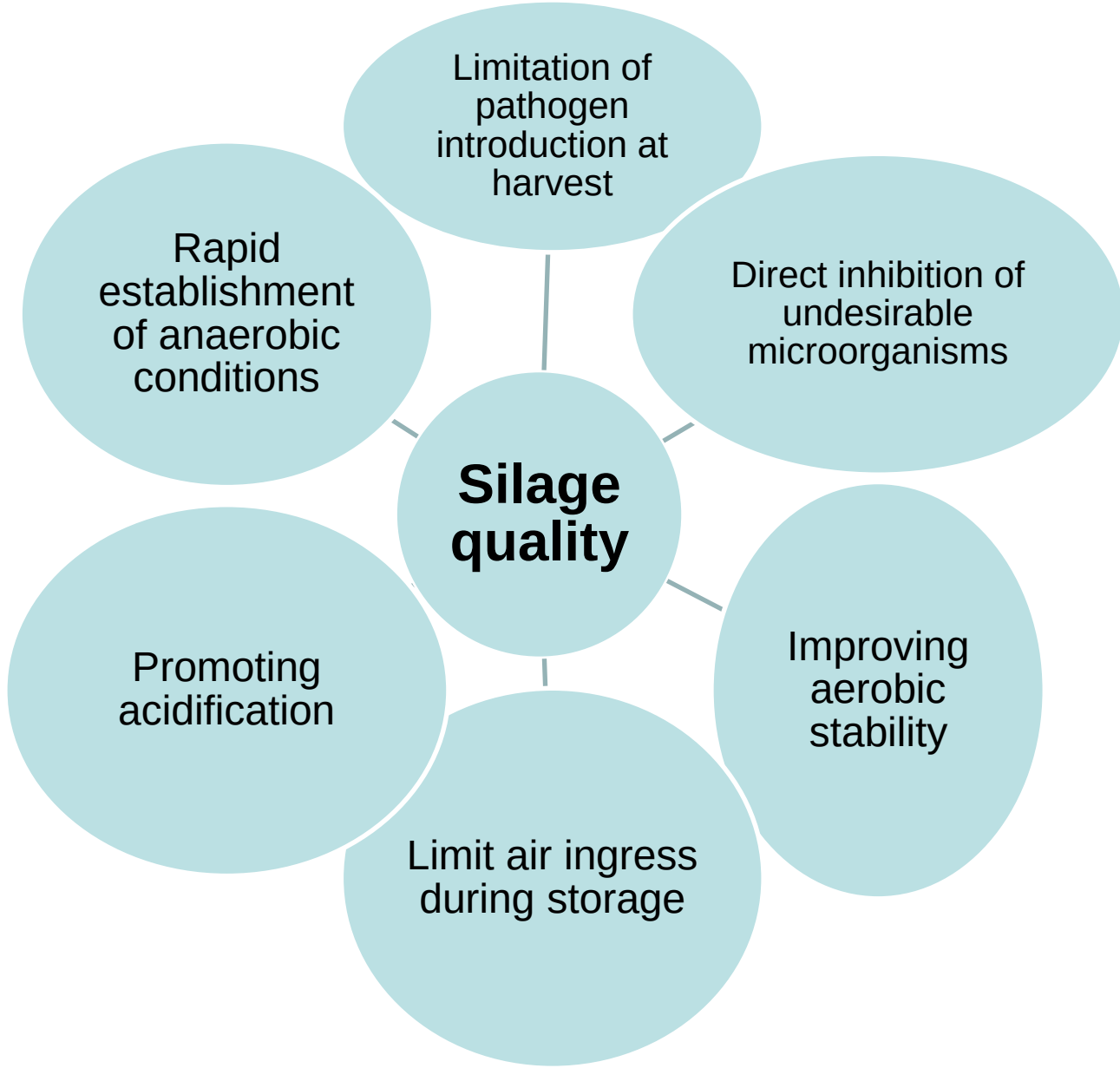
GP = 24 h in vitro gas production, ME = Metabolizable energy, WSC = Water-soluble carbohydrates

Delayed sealing → Decrease in digestibility, energy content and protein quality

Brüning et al. (in press)

Approaches for high-quality silages

Rapid sealing

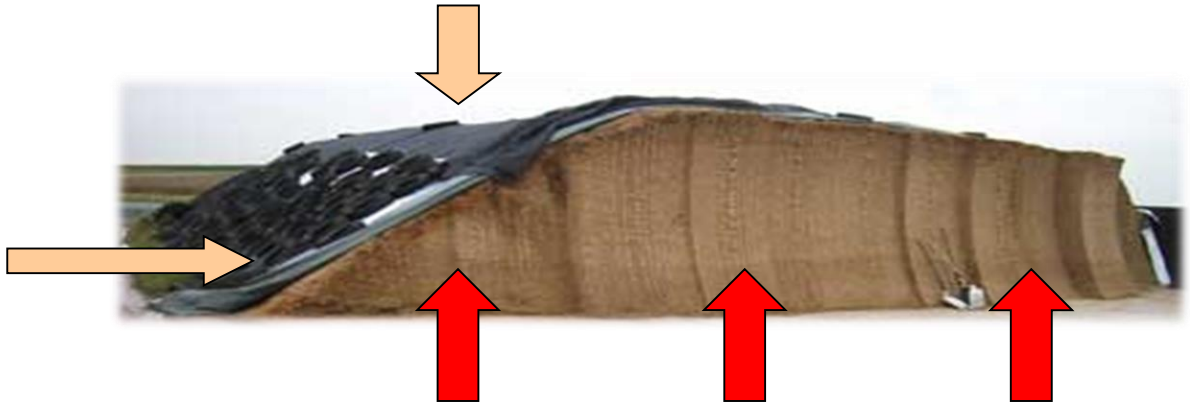


Dunière et al. 2013, modified

Silage quality is not a constant…

- Assessment at silo opening

→ **No aerobic degradation processes**



– Penetration of oxygen 1-2 m, air exposure in fodder mix waggon, feeding trough,..

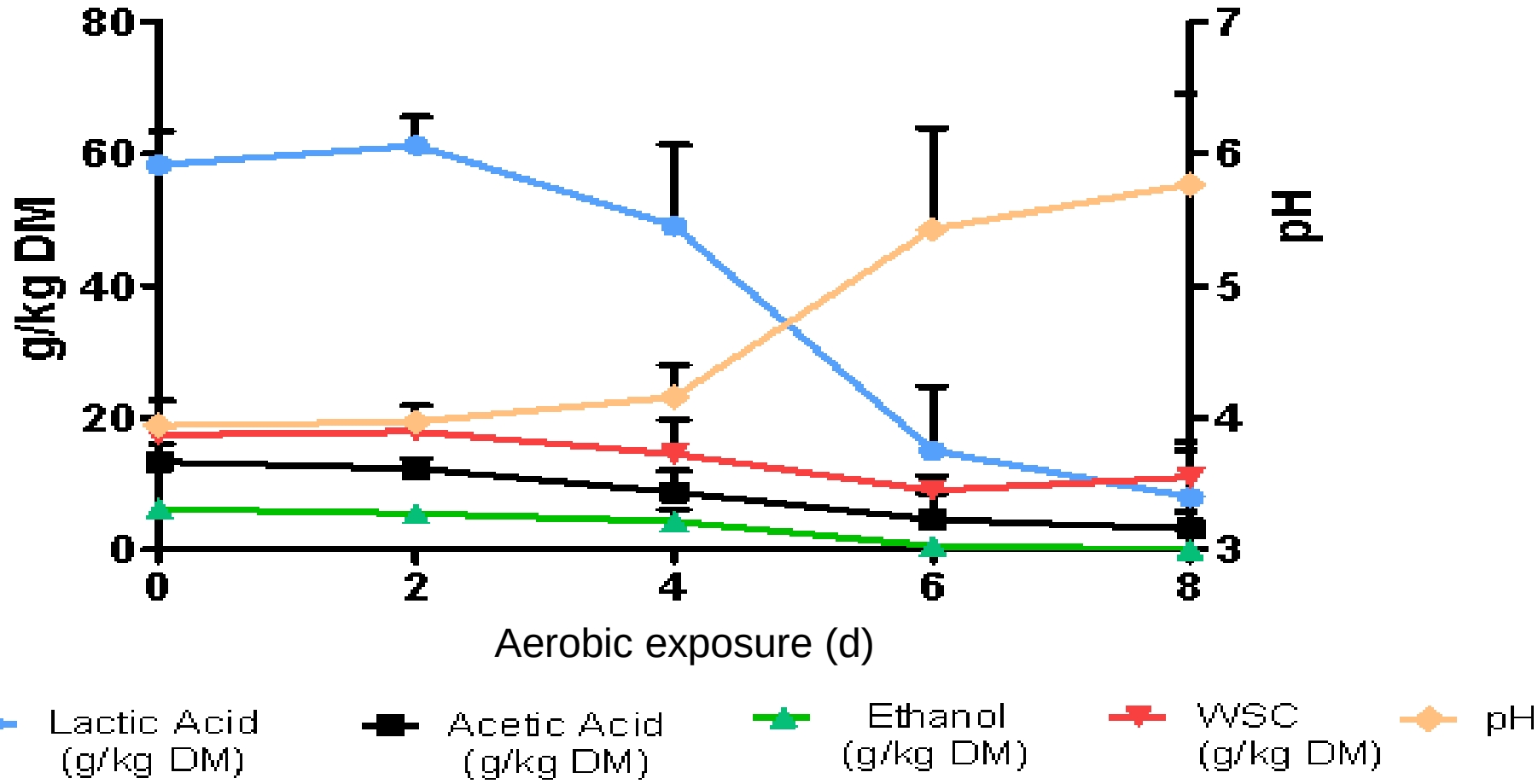
→ **Exposure to air > 1 week possible**

Aerobic deterioration of silages

- Proliferation of spoilage organisms
- Increase in silage temperature and pH
- Changes in chemical composition
  - Losses of dry matter and nutrients
  - Changes in fermentation pattern
  - **Accumulation of degradation products**
  - **Formation of mycotoxines**
- **Effect on feed intake?**

Aerobic exposure of maize silages

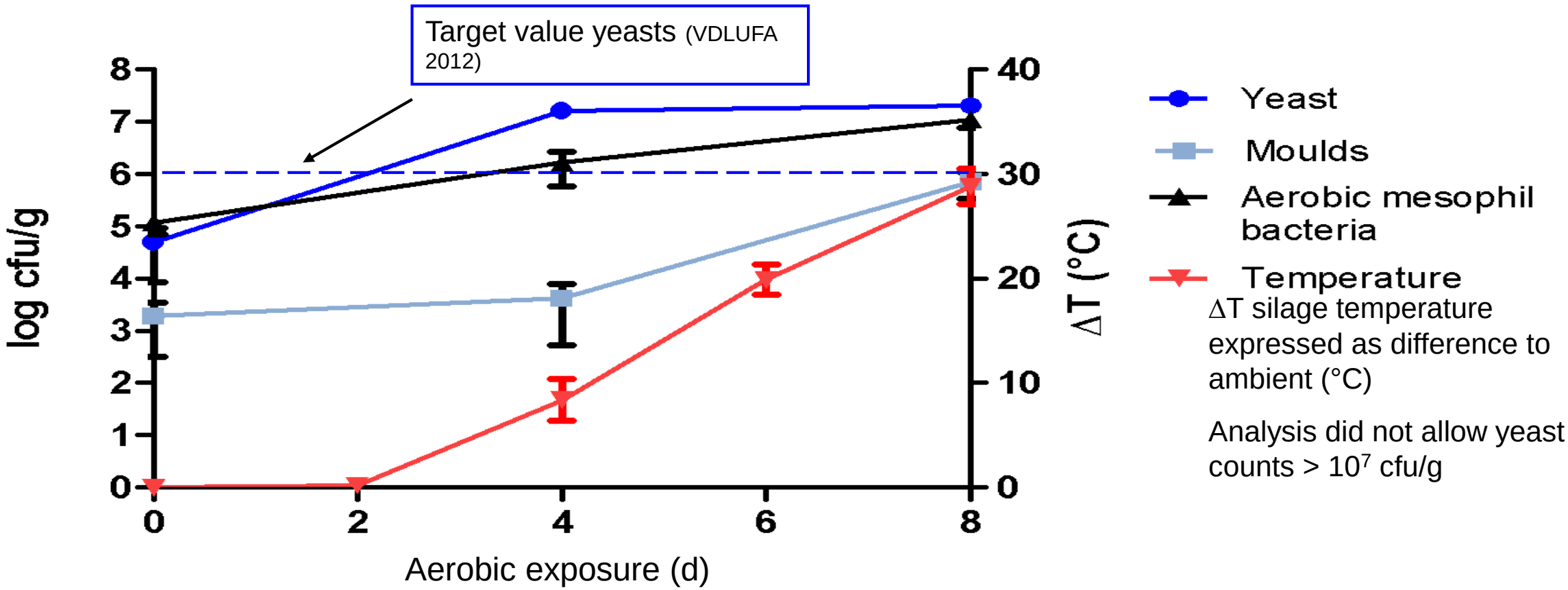
Mean concentration of selected variables in eight maize silages during eight days of aerobic exposure



Gerlach et al. 2013

Aerobic exposure of maize silages

Mean counts of spoilage organisms (colony-forming units (cfu)/g) in eight maize silages during eight days of aerobic exposure

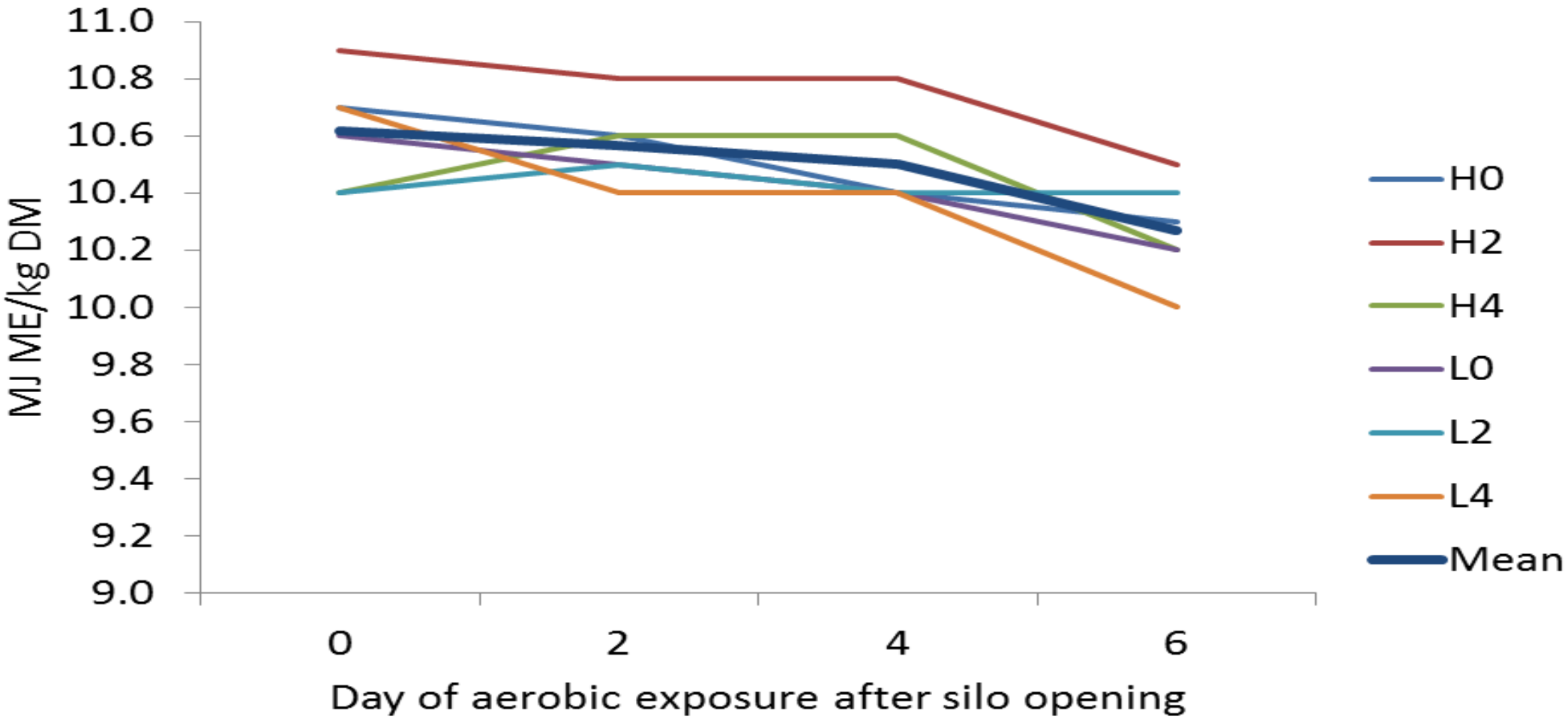


ΔT silage temperature expressed as difference to ambient (°C)

Analysis did not allow yeast counts > 10^7 cfu/g

Gerlach et al. 2013

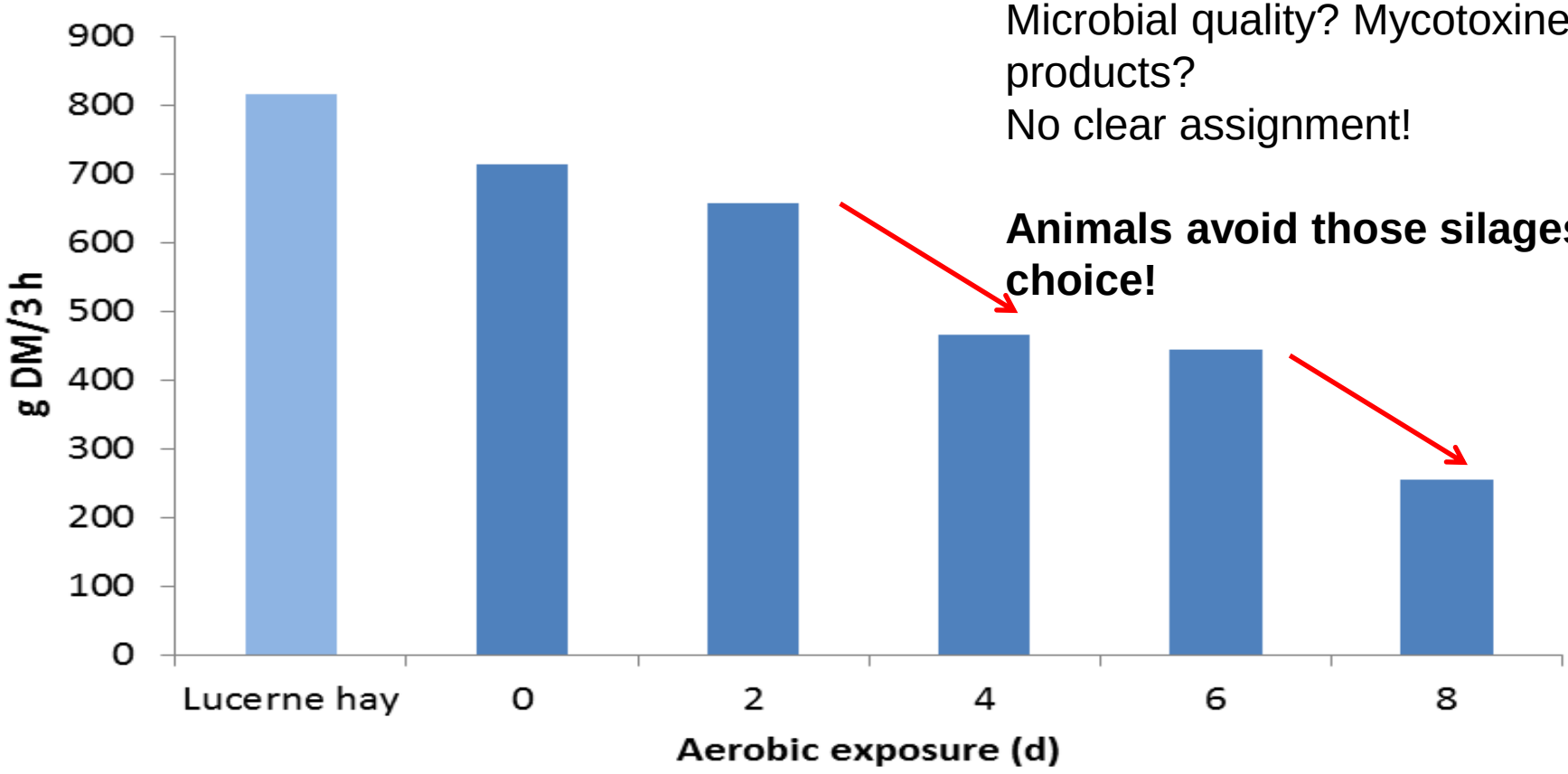
Effect of aerobic exposure after ensiling on feeding value of maize silages



Brüning et al. (in press)

Aerobic exposure of maize silages

Dry matter intake of lucerne hay and maize silages after 0-8 days of exposure to air shown by six goats (n=30)



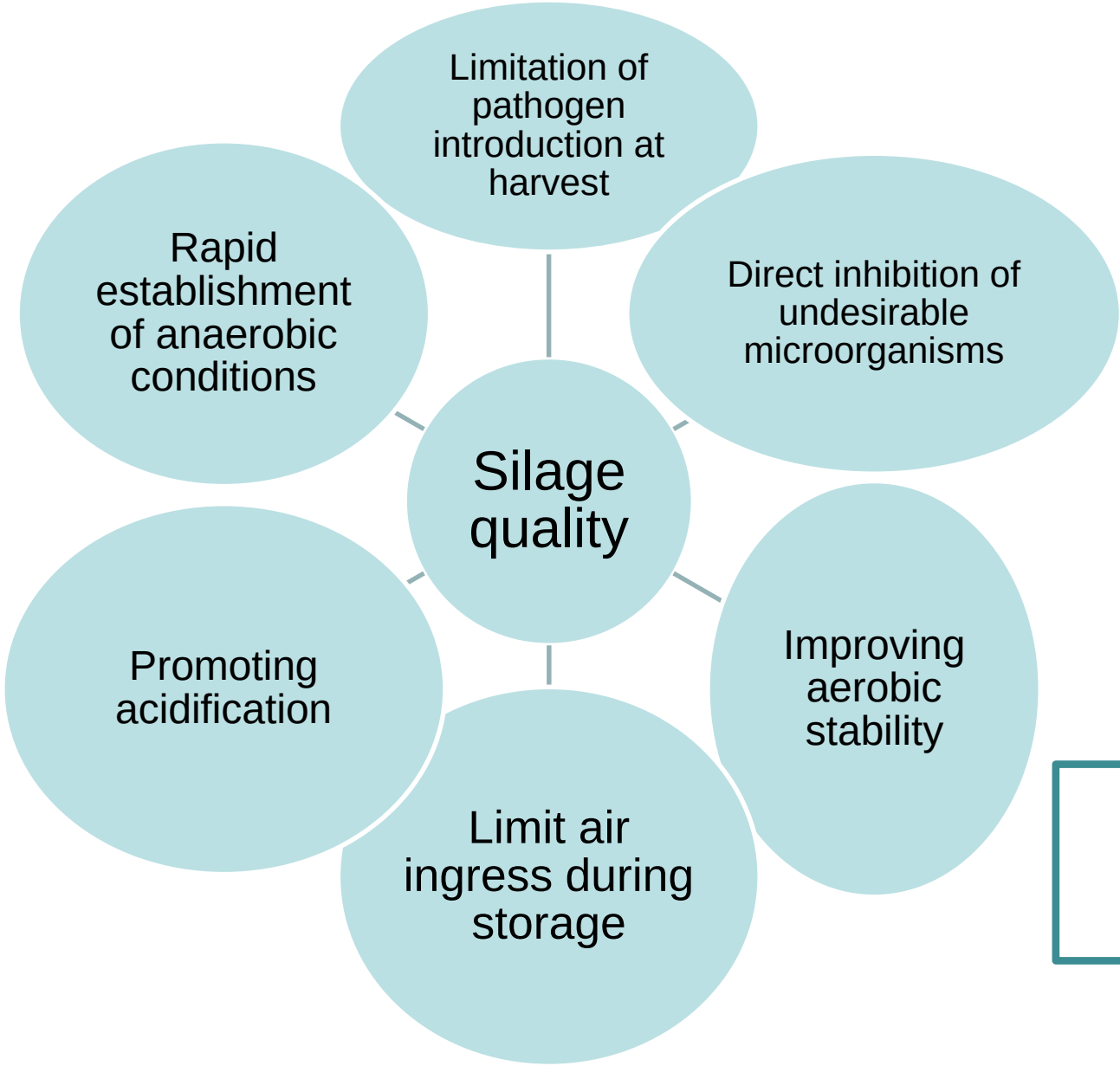
Reason for the decline?
Microbial quality? Mycotoxines? Fermentation products?
No clear assignment!

Animals avoid those silages when having a choice!

Gerlach et al. 2013

Approaches for high-quality silages

Rapid sealing



Avoid air ingress

Dunière et al. 2013, modified

Shredlage vs. conventionally harvested maize silage

Digestibility (%)	Shredlage	Maize silage
Organic matter	80.5	81.0
Crude fat	75.8	73.4
Crude protein	[illegible]	[illegible]6
aNDFom	64.2	64.0
ME (MJ/kg DM)	11.80	11.83

→ **No difference**

Pries et al., 2016

ww.shredlage.com

Summary

- The feeding value of maize silages is **highly variable**!

- A **number of factors** causes variation in the feeding value of maize silages
- Most of the variation originates from **differences in the maturity of maize at harvest**

- Furthermore, several factors influence the feeding value of silage maize **pre- and post-ensiling**
  - Ensiling process increases digestibility and energy concentration
  - **Delayed sealing** increases losses and decreases feeding value
  - **Aerobic deterioration** after silo opening decreases feeding value and intake

Summary

To improve the feeding value of your maize silages

→ Optimize harvest date and ensiling conditions

→ Avoid delayed sealing, air ingress etc.

→ Use additives (where necessary)

→ Don´t open the silo too early

→ Avoid aerobic exposure after silo opening

→ Strive for the best possible silage quality AND maintain it!

Thank you!

Peterson Farm Bros, 2014 (modified)