Carbon absorption in silages: 
a novel approach in silage microbiology
Development of a methodology for collecting all gases from fermentation
Schmidt et al. Greenhouse gas emissions from fermentation of corn silage
Souza et al. Does the silage absorb air during its fermentation? A lab trial on maize silages added with natamycin.
Pilot trial:
Internal pressure and gas absorption
Ph.D. student dedicated to this project

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Background

Li et al. (2017) reported an unknown behaviour of negative pressure inside silos

“...partial CO₂ dissolution in interstitial silage water”
Background

First acetogenic bacteria (*Clostridium aceticum*) described by Wieringa in 1936:

\[
4H_2 + 2CO_2 \rightarrow CH_3COOH + 2H_2O
\]

**Harland G. Wood** - entire career dedicated to CO₂ fixation

Wood (1952) - first study with \(^{13}\)CO₂ proving incorporation of CO₂ during acetate formation

Autotrophic Acetyl-CoA pathway of CO₂ fixation only established in the 90’s.

**The “Wood-Ljungdahl Pathway” (1991)**
Background

Figure 1.
The Wood-Ljungdahl pathway. “H₂” is used in a very general sense to designate the requirement for two electrons and two protons in the reaction.

(Rasgdale and Pierce, 2008)
Objectives

1. To evaluate the pressure inside the silos of maize silage.

2. To quantify the CO$_2$ absorption throughout the storage period.
**Material and methods**

Eight PVC silos (8.8 L) properly sealed. Maize forage (332 g kg$^{-1}$ DM) Storage at controlled-temperature room (24 ±1 ºC) for 5 months

Silos attached to a 3-way valve and to a 1-L chamber made of low-density polyethylene, for collecting all gases. Chamber immersed in water

Pressure inside the silos assessed using a mercury column manometer

Once the pressure become negative, four silos were weekly fed with pure CO$_2$. The gas was not forced inside the silos!

After 147 days, silos were opened. Samples taken for pH measuring.
Material and methods
Material and methods
Results

11 days of gas production
3,235 ± 388 mL kg\(^{-1}\) DM

Increased negative pressure until 101 days for silos kept closed
-43 ± 2.6 mm Hg (-5.7 kPa)
Results

19 supplies of CO$_2$
5,590±2492 mL of CO$_2$ were absorbed

Absorption continued throughout the trial!

pH closed - 3.76±0.03
pH CO$_2$ - 3.63±0.02
Discussion

The Wood-Ljungdahl pathway is an energy-generating process of reducing CO$_2$ to acetate under anaerobiosis.

22 bacterial genera are described (Drake at al, 2008)

This process has never been described for silages!

In the future silos can become bioreactors fixing pollutant gases from farm activities (CO, CO$_2$, N$_2$O) into high quality nutritive compounds of feed.
Where can we go?

Liew et al. (2016)

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Conclusion

Maize silage seems to be able for absorbing and fixing CO$_2$ by the Wood-Ljungdahl pathway.
Thank you!

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