EFFECT OF A SILAGE INOCULANT CONTAINING *L. DIOLIVORANS* ON CO_2 EMISSIONS OF CORN SILAGE DURING ANAEROBIC AND AEROBIC STORAGE

Gerd-Christian Maack[1], Ewald Kramer[2], Johanna Witt[2] , Kristin Rang[1] and Wolfgang Büscher[1]

[1]Institute of Agricultural Engineering, University of Bonn, Germany
[2]ISF GmbH, Pinneberg, Germany
c.maack@uni-bonn.de

Background & Objective

- Silage contributes to climate-relevant emissions (CO_2, nitrous gases, volatile organic compounds (VOCs)) and dry matter losses during both anaerobic and aerobic storage phases, impacting environmental and economic sustainability
- Silage inoculants based on heterofermentative lactic acid bacteria (LAB) can reduce greenhouse gases (GHG) and VOC emissions, especially under aerobic conditions during reheating, enhancing aerobic stability and livestock productivity

Aim: to investigate the effect of a LAB inoculant on fermentation quality, aerobic stability and GHG emissions in corn silage

Conclusion

The study demonstrates the effect of an LAB mixture containing L. diolivorans on aerobic stability and CO_2 emission losses during the reheating process after a short storage period. Thus, appropriate LAB mixtures have the potential to be part of emission reduction strategies in livestock production.

Results

- For the mini silos (MS), lactic acid and acetic acid were increased, and pH was significantly reduced in INO (LAB-treated silage) compared to CON (untreated silage) at both opening days (OD); Aerobic stability was improved at OD14 (CON: 1.3 d; INO: 8.0 d), while both CON and INO remained stable at OD90 (Table 1)
- CO_2 emissions during the anaerobic storage (OD14 and 90) were 2.9g and 4.5g for CON and 3.5g and 6.0g for INO (+20 % vs. CON) in the MS

Table 1: Silage parameters of the corn silages after opening day 14 (OD14) and 90 (OD 90) for control (a) and treated LAB mixture (b) ensiled in mini silos (MS)

Parameter	14**OD**		90**OD**	
	a	b	a	b
DM_c (%)	44.4	43.6	43.3	42.5
LA (% DM)	1.74^a	2.58^b	2.13^a	2.45^b
AA (% DM)	0.59^a	1.67^b	0.97^a	3.13^b
pH	4.38^a	3.97^b	4.18^a	3.97^b
WL (% DM)	1.77	2.33	2.83	3.67
AS (days)	1.30^a	8.00^b	>14	>14

(*DM_c = DM corrected, LA=Lactic acid; AA= Acetic acid; AS= Aerobic stability (max. length: 14 days); WL= Weight losses; ^{a,b} symbolize significant differences (*P<0.05)*)

- For the mini silos with integrated injection lance (MSIL), CON started to heat up after about one day, the INO remained stable during the 14 d of aerobic exposure (Figure 1, left); CO_2 emissions demonstrate similar pattern; CO_2 concentration of CON (146,000ppm) were significantly higher than to INO (7,600ppm), (Figure 1, right). At OD90, aerobic stability and CO_2 emissions were very low (CON: 7,500 and INO: 7,200ppm) because there was no reheating in both treatments
- Calculating the mass of emitted CO_2 based on the sum of air exhausted from the MSIL and the mean CO_2 concentration during 14 days of reheating, 192g CO_2 was emitted from 0.75kg FM corn silage ensiled in each MSIL. In contrast, only 9.7g CO_2 was emitted from one MSIL of the LAB treatment

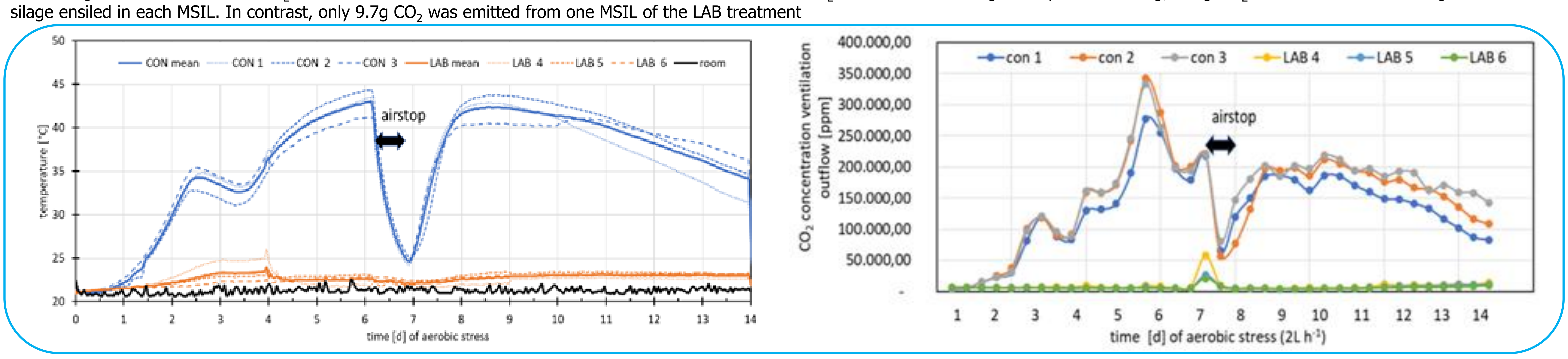

Figure 1: Silage temperature (left) and emitted CO_2 concentrations in the exhaust air (right) during aerobic stability test at opening day (OD) 14 for control (CON 1-3) and treated samples (LAB4-6) ensiled in the mini silos with injection (MSIL). Note: The air injection failed at day 7 for 14h, so the temperature and CO_2 concentrations dropped immediately

Methods

- Corn silage (41% DM) was ensiled in 1.5 L mini silos (MS) and in 1.5L mini silos with integrated injection lance (MSIL) at 20 °C for 14 and 90 days at 20°C in three replicates
- Treatments consisted of an untreated control (CON) and treated (INO) with a mixture of homo- and heterofermentative LAB (Bonsilage Speed M: *L. diolivorans, L. buchneri and L. rhamnosus*; application rate of 250.000 CFU/ g FM)
- Aerobic stress was simulated after 7 days of storage for 24h; and for MS aerobic stability was assessed using Honig's (1990) method; and for MSIL, aerobic stability test was simulated by injection of 2L air per hour (Figure 2 a, b) and air exhaustion twice daily, which leads to very intensive air stress
- CO_2 emissions were monitored for MSIL during anaerobic storage and aerobic stability test
- Statistical evaluation: the data were examined by SAS, including Kruskal-Wallis test for significant differences (P<0.05) between CON and INO

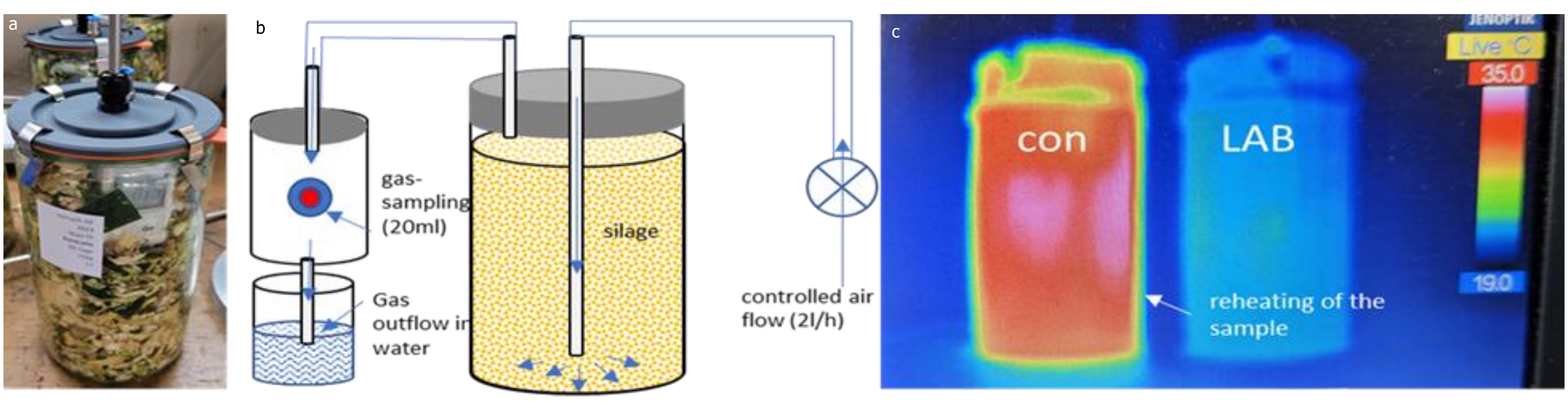

Figure 2: Experimental setup for aerobic stability and gas sampling using controlled airflow through the silage (a, b); thermogram of two mini silos (control vs. treatment) after 7 days of aerobic test (c)

c.maack@uni-bonn.de

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