

# Re-ensiled press cakes

## Forage and fermentation quality of grass silages from biorefinery

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# life farm4more

Climate Action | Green Feed | Biorefinery

**LIFE18CCM/IE/001195 – Action C.5.1**

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biochar **N**ergy



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# Introduction

- The need for sustainable feed production and protein self-sufficiency is growing in importance.
- Production of protein feed for monogastric animals via fractionation from green biomass is attracting more interest.
- Biorefinery is the processing of biomass into a range of marketable products and energy.
- In the Farm<sub>4</sub>More project (LIFE18CCM/IE/001195), various grass silages were biorefined with a screw press and the press cake was ensiled again.

# Material und Methods (1)

- **grass silage in bales**
  - origin: Lambach (upper Austria)
  - forage types: grass (9/2020), grass-clover-mix (7/2021), red clover (7/2021)
  - bale weight between 900 to 1,100 kg FM
- **biorefinery in two campaigns (9/2020 and 7/2021)**
  - scaling biomass of 4 bales for each forage type during process
  - watering of grass silage to 23 % DM after rapid DM-determination via microwave (method Losand und Waldmann 2003)
  - shredding of silage with mixing wagon (vertical cutter)
  - 4 round bales (replications) were pressed for each type of forage
  - re-ensiling press cakes in 60 liter plastic barrels – approx. 45 kg FM
  - For each bale 4 barrels were filled with press cake

## Material und Methods (2)

- **fermentation of grass silages in barrels**
  - average compaction was 275 to 281 kg DM/m<sup>3</sup>
  - duration of fermentation 52 to 62 days
  - room temperature for storage approx. +20°C
- **barrel opening and sampling**
  - opening in campaign 1: 01/2021; in campaign 2: 09/2021
  - scaling of net weight
  - probe cylinder (Ø 50 mm), 2 drill cores per barrel × 4 rep. = 8 cores per sample
  - rapid colling of samples
- **chemical and statistical analysis**
  - laboratory analysis according to VDLUFA Methodenbuch III
  - Statgraphics XVII: variance analysis p-level 95 %, Tukey-HSD

# process of bio-refining grass silage

process



press juice



press cake



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# Results and Discussion

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# grass silage vs. re-ensiled press cake of biorefinery (1)

## DM- and protein contents

parameter	abbrev.	unit	silage absolut (benchmark)			re-ensiled presscake absolut			re-ensiled presscake relative difference to benchmark [%]		
			grass (pre trial)	grass/clover	red clover	grass (pre trial)	grass/clover	red clover	grass (pre trial)	grass/clover	red clover
Dry matter	DM	g/kg FM	419.6 <sup>C</sup>	316.3 <sup>B</sup>	249.4 <sup>A</sup>	372.0 <sup>a</sup>	369.2 <sup>a</sup>	372.3 <sup>a</sup>	88.7 <sup>a</sup>	116.9 <sup>b</sup>	149.3 <sup>C</sup>
Crude protein	XP	g/kg DM	135.1 <sup>A</sup>	145.8 <sup>A</sup>	158.8 <sup>B</sup>	101.7 <sup>a</sup>	116.2 <sup>b</sup>	126.0 <sup>C</sup>	75.4 <sup>a</sup>	79.7 <sup>a</sup>	79.5 <sup>a</sup>
Ammonia	NH <sub>3</sub>	g/kg DM	1.8 <sup>A</sup>	2.3 <sup>AB</sup>	2.7 <sup>B</sup>	1.2 <sup>a</sup>	1.3 <sup>a</sup>	1.2 <sup>a</sup>	67.0 <sup>b</sup>	54.5 <sup>ab</sup>	47.1 <sup>a</sup>
NH <sub>3</sub> of N <sub>total</sub>		%	8.3 <sup>A</sup>	9.8 <sup>A</sup>	10.3 <sup>B</sup>	7.3 <sup>b</sup>	6.7 <sup>ab</sup>	6.0 <sup>a</sup>	87.9 <sup>b</sup>	68.3 <sup>a</sup>	59.8 <sup>a</sup>

### Statistics:

Test Tukey-HSD (95%)

### Indizes:

Capital letters show differences in grass silage

Lower case letters show absolute differences of the different re-ensiled press cakes

Lower case letters show relative differences between grass silage and re-ensiled press cakes

## grass silage vs. re-ensiled press cake of biorefinery (2)

### fibre-/nonfibre carbohydrates

parameter	abbrev.	unit	silage absolut (benchmark)			re-ensiled presscake absolut			re-ensiled presscake relative difference to benchmark [%]		
			grass (pre trial)	grass/clover	red clover	grass (pre trial)	grass/clover	red clover	grass (pre trial)	grass/clover	red clover
Neutral detergent fiber	NDF	g/kg DM	496.3 <sup>C</sup>	390.2 <sup>B</sup>	342.8 <sup>A</sup>	634.5 <sup>C</sup>	492.5 <sup>b</sup>	440.0 <sup>a</sup>	127.9 <sup>a</sup>	126.2 <sup>a</sup>	128.5 <sup>a</sup>
Acid detergent fiber	ADF	g/kg DM	336.3 <sup>C</sup>	294.9 <sup>A</sup>	309.0 <sup>AB</sup>	433.7 <sup>a</sup>	402.8 <sup>a</sup>	411.8 <sup>a</sup>	129.2 <sup>a</sup>	136.8 <sup>a</sup>	133.4 <sup>a</sup>
Acid detergent lignin	ADL	g/kg DM	41.0 <sup>A</sup>	32.9 <sup>A</sup>	39.3 <sup>A</sup>	49.3 <sup>b</sup>	40.5 <sup>a</sup>	47.6 <sup>b</sup>	122.5 <sup>a</sup>	123.3 <sup>a</sup>	121.5 <sup>a</sup>
Non fibre carbohydrates	NFC	g/kg DM	198.8 <sup>A</sup>	280.6 <sup>B</sup>	279.6 <sup>B</sup>	102.3 <sup>a</sup>	184.0 <sup>b</sup>	228.8 <sup>b</sup>	51.4 <sup>a</sup>	65.7 <sup>b</sup>	82.0 <sup>c</sup>
Sugar	XZ	g/kg DM		86.7 <sup>B</sup>	40.4 <sup>A</sup>		6.5 <sup>a</sup>	5.5 <sup>a</sup>		7.6 <sup>a</sup>	13.7 <sup>b</sup>

#### Statistics:

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# grass silage vs. re-ensiled press cake of biorefinery (2)

## contents of minerals

parameter	abbrev.	unit	silage absolut (benchmark)			re-ensiled presscake absolut			re-ensiled presscake relative difference to benchmark [%]		
			grass (pre trial)	grass/clover	red clover	grass (pre trial)	grass/clover	red clover	grass (pre trial)	grass/clover	red clover
Crude ash	XA	g/kg DM	87.1 <sup>A</sup>	106.7 <sup>B</sup>	110.7 <sup>C</sup>	63.0 <sup>a</sup>	81.2 <sup>b</sup>	884.4 <sup>b</sup>	72.4 <sup>a</sup>	76.2 <sup>a</sup>	76.2 <sup>a</sup>
Calcium	Ca	g/kg DM	8.4 <sup>A</sup>	12.3 <sup>B</sup>	14.5 <sup>C</sup>	6.3 <sup>a</sup>	10.2 <sup>b</sup>	12.3 <sup>c</sup>	75.1 <sup>a</sup>	82.9 <sup>b</sup>	84.8 <sup>b</sup>
Phosphorus	P	g/kg DM	3.08 <sup>A</sup>	3.02 <sup>A</sup>	3.03 <sup>A</sup>	1.8 <sup>a</sup>	1.5 <sup>a</sup>	1.5 <sup>a</sup>	58.6 <sup>a</sup>	50.5 <sup>a</sup>	50.0 <sup>a</sup>
Potassium	K	g/kg DM	28.1 <sup>A</sup>	30.2 <sup>AB</sup>	31.7 <sup>B</sup>	13.4 <sup>a</sup>	17.2 <sup>b</sup>	18.1 <sup>b</sup>	48.6 <sup>a</sup>	58.2 <sup>a</sup>	58.8 <sup>a</sup>
Iron	Fe	mg/kg DM	900 <sup>B</sup>	447 <sup>A</sup>	519 <sup>A</sup>	1087 <sup>a</sup>	676 <sup>a</sup>	743 <sup>a</sup>	121.7 <sup>a</sup>	152.1 <sup>a</sup>	143.4 <sup>a</sup>

**Statistics:**

Test Tukey-HSD (95%)

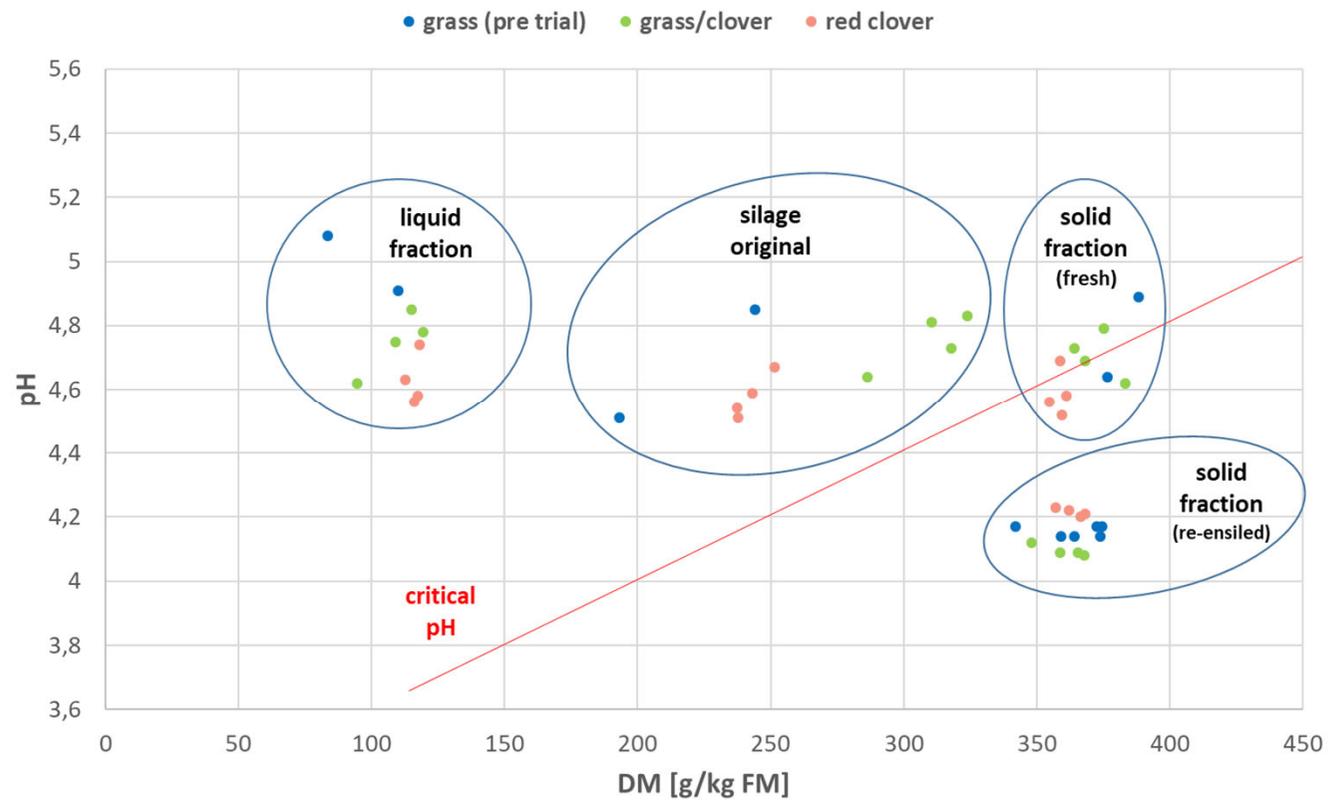
Indizes:

Capital letters show differences in grass silage

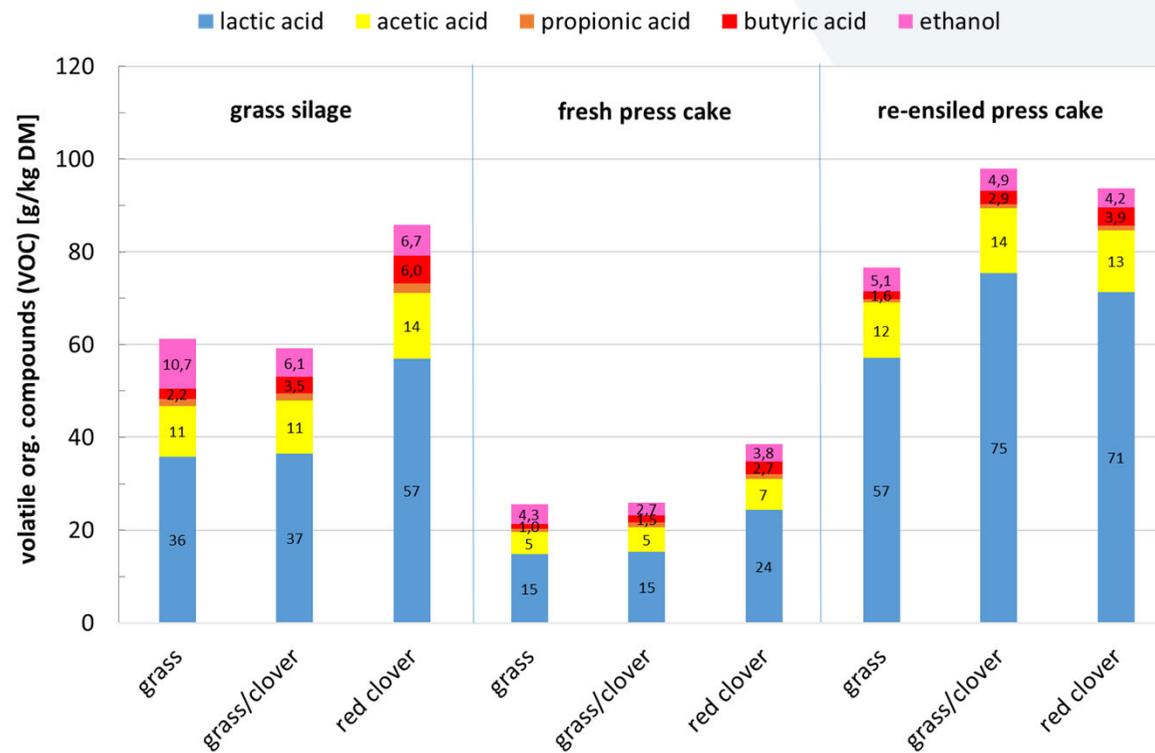
Lower case letters show absolute differences of the different re-ensiled press cakes

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## pH-values of grass silages and biorefined fractions



## Fermentation products of silage press cakes of biorefinery



# Conclusions



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## Conclusion on re-ensiled press cakes of biorefinery

- **Big Change of nutrients of grass silage due to pressing**
  - increase of NDF by approx. 100 g/kg DM
  - decrease of crude protein by 11 to 24 %
  - decrease of minerals by 25 to 30 %
  - decrease of sugar by 50 %
  - decrease of fermentation products (VOC) by 55 to 57 %
- **Fermentation quality of re-ensiled press cakes**
  - significant lactic acid fermentation after successful re-ensilation
  - mobilisation of fermentable carbohydrates from NFC (maybe also from hemicellulose molecules?)
  - no spoilage of the solid fraction due to air contact and high temperature after pressing!
  - very good stability and fermentation quality of re-ensiled press cake from the biorefinery



# Thank you for your attention!



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