Grass silage for biorefinery: Fermentation quality and nutritional composition of press cake and juice

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INTRODUCTION

- Valorization of green biomass through the green biorefinery provides opportunities to create diverse high value products.
- Solid fraction (press cake) produced from biorefinery can be stabilized by ensiling which can be used e.g as ruminant feed, fibrous materials.

The aim of the study was to compare the fermentation quality of grass ensiled as fresh, wilted or press cake with various additives and evaluate the subsequent influence on liquid yield and composition of press juice.

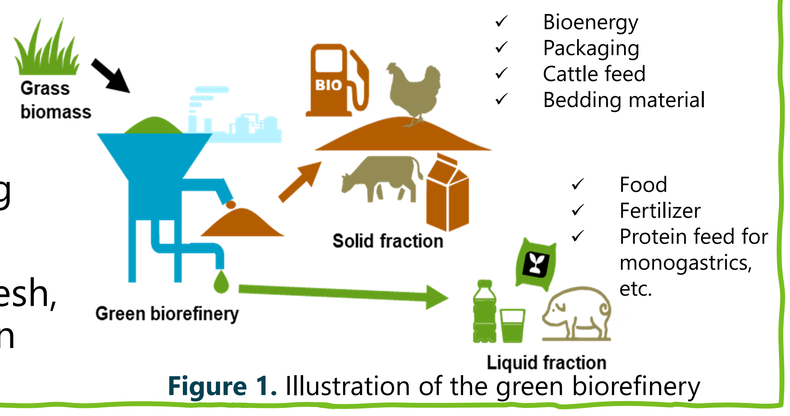


Figure 1. Illustration of the green biorefinery

MATERIALS AND METHODS

- ❖ Second cut pure timothy (*Phleum pratense*) harvested on 31 July, 2023 in Jokioinen, Finland.
- ❖ 3 biomass types:
  - Fresh (grass as such)
  - Press cake (from mechanical liquid-solid separation of grass with pilot scale press)
  - Wilted (grass pre-dried for 5 hours with artificial dryer)
- ❖ Additive treatments used:
  - Control without additive (CON)
  - Lactic acid bacteria (LAB)
  - Formic and propionic acid-based additive (FA, 5l/t; AIV 2 Plus Na, Eastman, Oulu, Finland)
- ❖ Ensiled in cylindrical silos for 88 days in replicates of 3.
- ❖ All ensiled biomasses were pressed with a lab-scale double screw press.

Figure 2. Mechanical pressing of a) fresh grass using a pilot scale single screw press, b) ensiled biomass using a lab-scale double screw press.

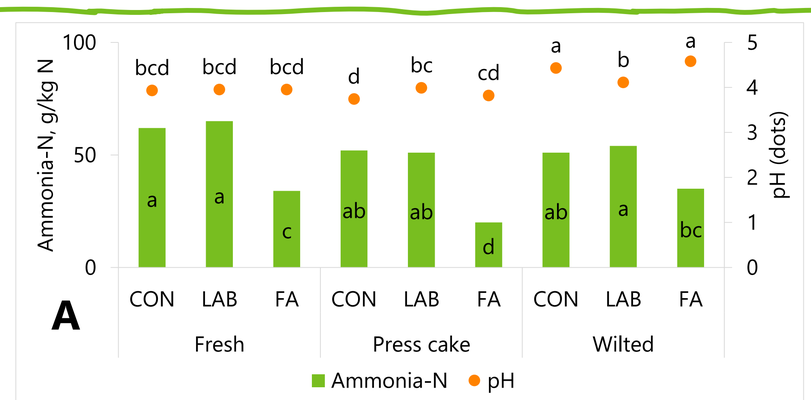
RESULTS

- Screw-pressing and drying increased dry matter of Press cake and Wilted but crude protein levels remained stable across all treatments (Table 1).
- Press cake and Wilted had an intermediate ensilability while Fresh fell within difficult ensilability category (Table 1).
- All silages achieved good fermentation quality while FA treatment improved it further by reducing ammonia-N levels (Figure 3A).
- Treatment with FA increased the water soluble carbohydrates in Wilted even beyond the original biomass due to acid hydrolysis of fiber (Figure 3B & C).
- Liquid CP concentration increased LAB treatment while crude protein retention in press juice was lower with screw-pressing, wilting and FA treatment (Figure 3D).

Table 1. Chemical composition of original biomasses prior to ensiling.

Biomass characteristics	Fresh	Press cake	Wilted
Dry matter, g/kg	195	230	301
In dry matter, g/kg			
Ash	90	83	91
Crude protein	130	130	132
Nitrate-N	0.14	0.08	0.08
Water soluble carbohydrates	80	63	69
Neutral detergent fiber	596	597	578
Fermentation coefficient	33	35	41
IVOMD[1], g/kg organic matter	0.753	0.735	0.747

[1]In vitro organic matter digestibility



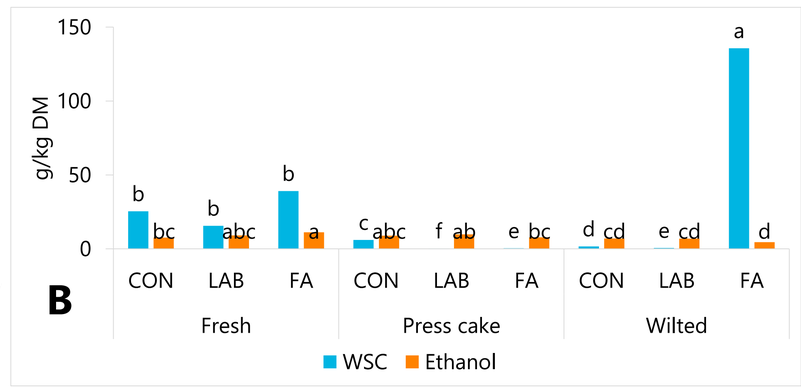
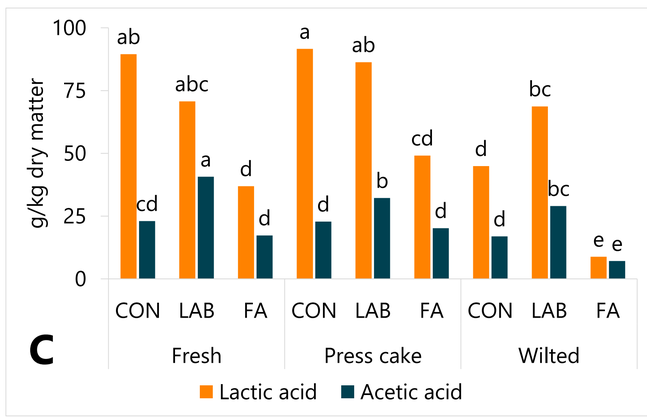
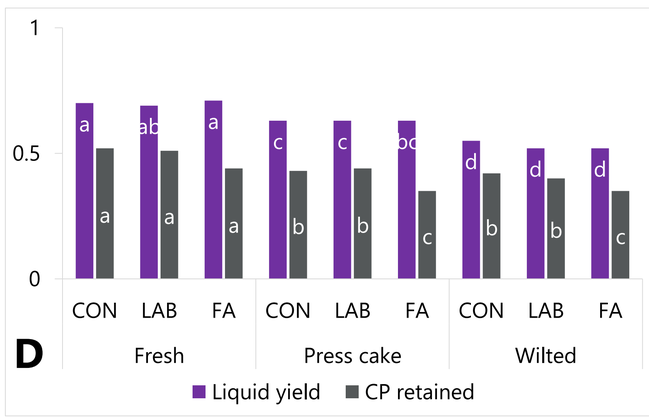


Figure 3. Fermentation characteristics and biorefinery output of ensiled fresh, press cake and wilted biomass.





Screw-pressing grass through biorefinery and subsequent ensiling offers a synergistic solution, optimizing silage production while stabilizing biorefinery products.

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