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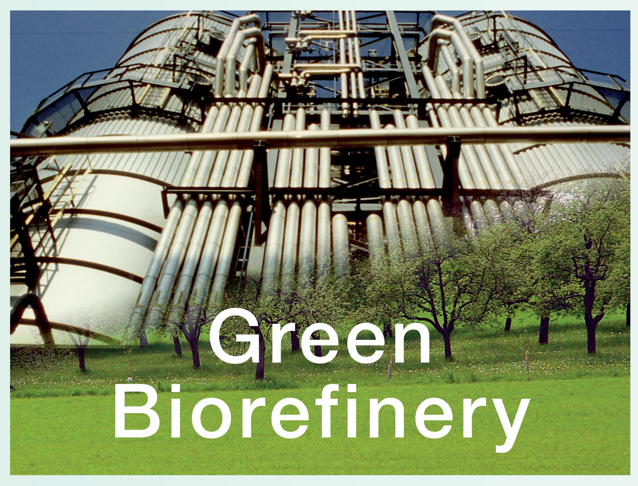
The Austrian Green Biorefinery (A-GBR)
Concept overview; results of lactic acid and amino acid yields in silage juice



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M. Mandl[1], N. Graf[1], J. Ringhofer[2], S. Kromus[2], H. Böchzelt[1], H. Schnitzer[1]

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JOANNEUM RESEARCH
Forschungsgesellschaft mbH
Institute of Sustainable Techniques and Systems
Michael Mandl

Elisabethstrasse 16–18
8010 Graz, Austria

Phone +43 / 316 / 876-2412
Fax +43 / 316 / 876-2430
michael.mandl@joanneum.at
nts@joanneum.at
www.joanneum.at/nts

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BiorefSYS –
Biorefinery Systems

Auersbach 130
8330 Feldbach, Austria
www.biorefinery.com

www.joanneum.at/nts

Introduction

The Green Biorefinery Austria Concept

Agriculture in Austria (as in the EU-countries) is currently undergoing structural change, which is characterized by a significant decrease of livestock and dairy farming. As a result, grassland area without a direct agricultural use is increasing dramatically. Thus, innovative technology concepts for the utilization of this abundant biomass resource are highly required for the future.

One new option for green biomass is offered by Green Biorefineries. Ideally, a Green Biorefinery produces a flexible mix of high-value products, including bulk chemicals, fuels and/or other materials (e.g. grass fiber products). Byproducts and residues are used for on-site generation of power (biogas) and heat.

The Austrian Green Biorefinery concept utilizes solid state fermentation (ensilaging) to meet two goals:

- to generate a storable raw material for a continuous industrial process
- to convert green biomass into valuable substances such as lactic acid and amino acids as marketable products.

The Austrian Biorefinery process can be subdivided into several "modules":

(1) Supply chain of raw material
(2) Pressing of silage to produce a silage juice and press cake
(3) Downstream processing of juice to separate lactic acid and amino acids products
(4) Treatment of press cake to generate possible fiber products
(5) Biogas generation from residues (liquid and solid).

Figure 1 shows an overview of the Austrian Green Biorefinery concept.

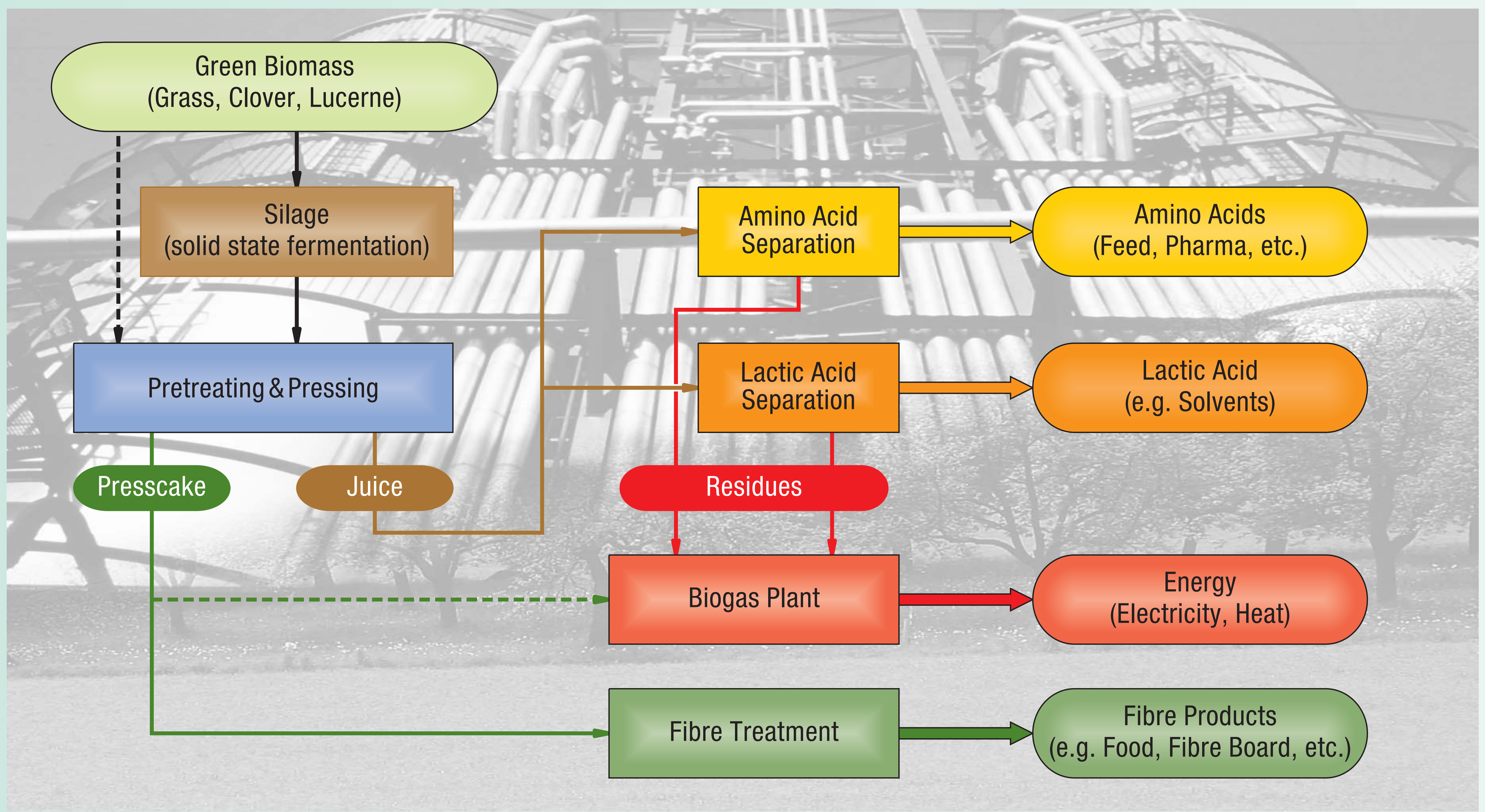

Figure 1: Green Biorefinery Austria overview

Figure 2: Set up of screw press

Figure 3: Loading the silage mixer with raw material

Focus of work

This poster presents results of pressing tests performed with the raw material silage.

The pressing itself is a fundamental process which strongly influences the composition of press juice. The overall goal of pressing is to transfer as much as possible of the valuable components lactic acid and amino acids into the press juice.

Methods and raw materials

For the pressing a small screw extrusion press of the type Vetter was used. The screw had an overall conical shape, a bottom diameter of 0.25 m and a screw thread of 1:7. The press was powered by a 7.5 kW engine (figure 2).

The pressing involved the following procedure

(1) Chopping and mixing of silage (figure 3)
(2) First pressing
(3) Adding Water to press cake #1 and mixing
(4) Second pressing

In order to state on the chemical composition of the press feed and the produced juice and press cake a set of samples was taken for each run.

Two different types of silage were used during the investigation

(A) clover-grass silage
(B) lucerne (alfalfa) silage

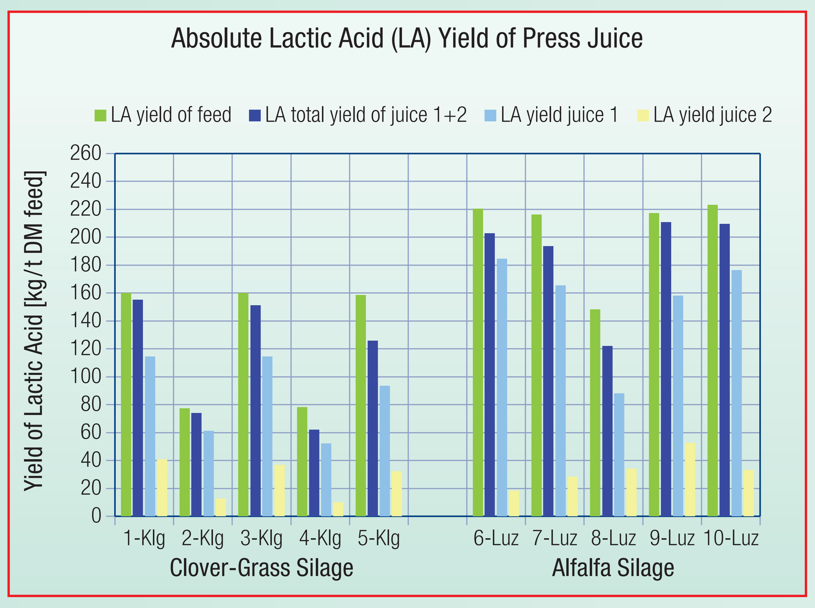

Figure 4: Absolute yields of lactic acid [kg/t DM feed]

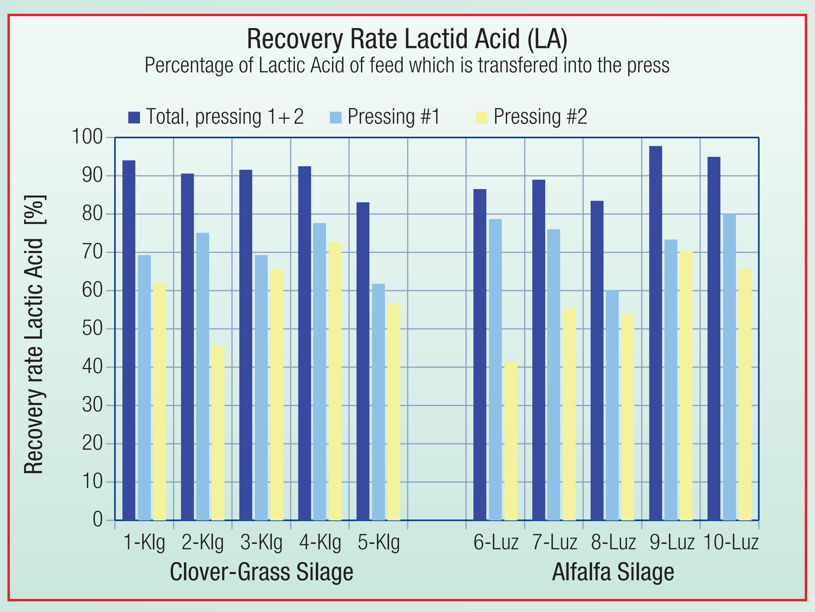

Figure 5: Recovery rate of lactic acid [%]

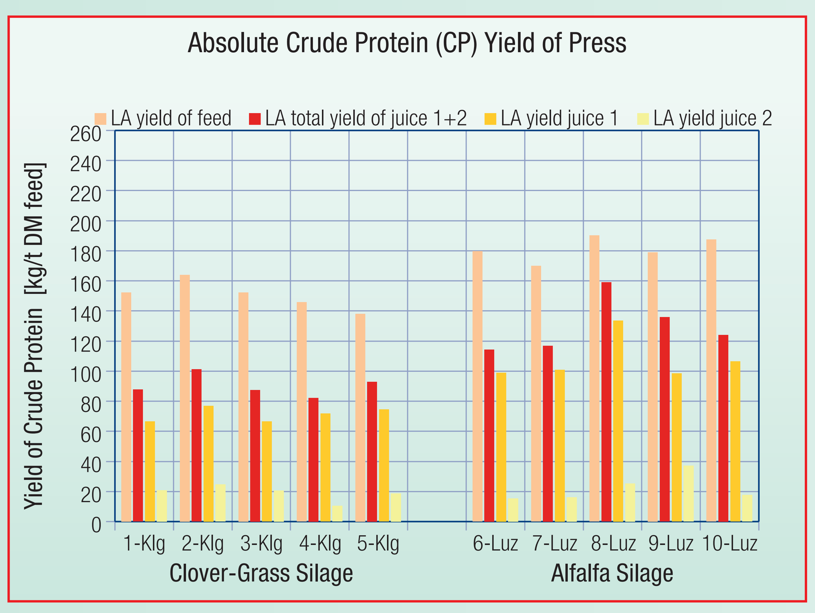

Figure 6: Absolute yield of crude protein [kg/t DM feed]

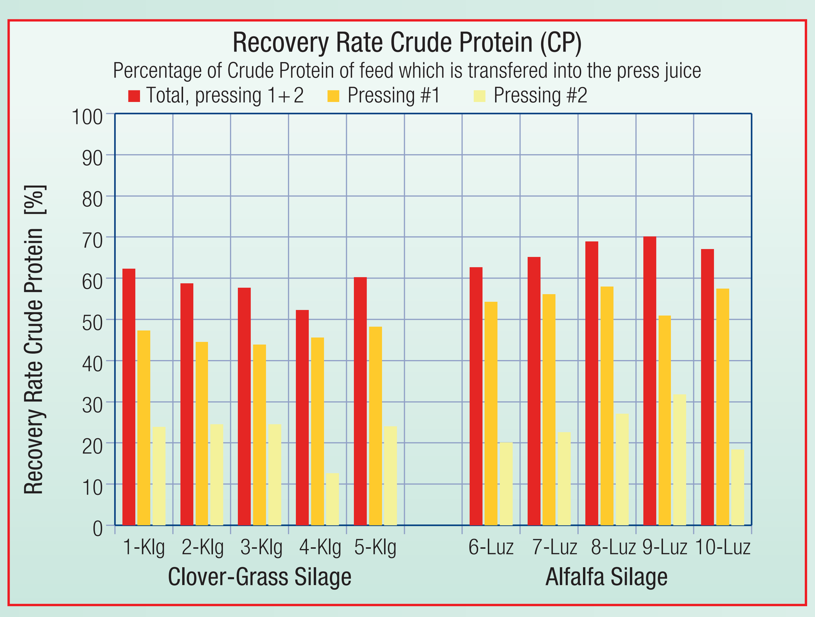

Figure 7: Recovery rate of crude protein [%]

Results

The results are plotted in the presented figures 4 to 7 which provide absolute yields [kg/t dry matter feed] as well as a relative recovery rate [%] for the components LA (lactic acid) and CP (crude protein). The figures are split into data sets for the raw materials clover-grass silage and alfalfa-silage. The presented data sets describe the original feed, the press juice #1, press juice #2, and the total yield of juice (pressing 1+2).

Lactic acid

Figure 4 shows the measured absolute yield of lactic acid (LA). The LA content was mostly found to be higher in the alfalfa silage than in the clover silage, peaking with values exceeding 220 kg/t DM. Possible total LA yield transferred into the juice (pressing 1+2) was found to be for alfalfa silage in the range of 185–210 kg/t DM feed and for clover grass silage in the range was of 120–155 kg/t DM feed. However the measured yields varied due to diverse silage quality of raw material.

The recovery rate of the LA component is presented in figure 5. Total recovery rate (pressing 1+2) was in most cases around 90 %, with top values up to 97 %. Although the absolute LA yields in the press juice #2 are rather small, still the corresponding recovery rate is in an acceptable range between 40–70 %.

Crude Protein

Corresponding to LA contents described above the crude protein content was again found slightly higher in the alfalfa silage than in the clover-grass silage. Total CP yield in the Juice (pressing 1+2) was mostly found to be in the range of 80–120 kg/t DM feed, top values up to 160 kg/t DM feed, depending on the original content of the feed. Total CP-recovery rates were mostly in the range of 55–65 %, top values up to 70 %. Results are plotted in figures 6 and 7.

Conclusion

The results in general indicate that the components lactic acid and crude protein can be well separated from silage and transferred into press juice by means of a screw press. In order to optimize fractionation of silage a double pressing procedure is recommended. Results indicate that 85–95 % of total lactic acid yield in the silage can be transferred into the juice. As far as the amino acids are concerned about 55–65 % of crude protein can be recovered in the press juice.

The gained silage juice is the raw material for further downstream processing in order to separate LA and amino acid (AA) products in a Green Bioreffinery.

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