Nurmisäilörehupohjainen nestemäinen rehu maittoi hyvin sioille ja lehmille

Grass silage based juice - palatability test for pigs and cows

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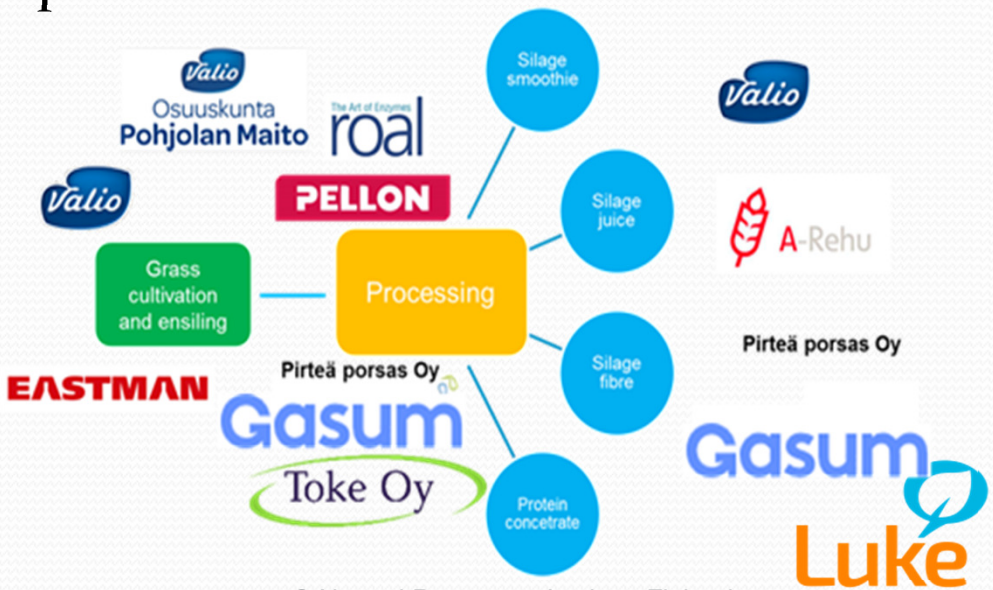
Innofeed project: Biorefining ensiled grass into inventive feed products

- Developing and testing methods to process grass silage into novel feeds suitable for monogastrics
- Targets: to improve protein self sufficiency, profitability and sustainability of agricultural production in Finland
- Funding from TEKES and companies
  - A-Rehu
  - Gasum
  - Pohjolan Maito
  - Pellon
  - Pirteä Porsas
  - Roal
  - Eastman
  - Toholammin Kehitys
  - Valio



Surplus grass biomass as raw material for green biorefineries

- Grass grows well in humid temperate areas with a capacity for high biomass production compared to annual crops
- Existing technology is available for its cultivation, harvesting and ensiling
- Due to its low lignin content, it is easier to process than wood or straw
- Grass offers a versatile raw material for feed and other purposes

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Potential to increase grass production from current level

- Increase production level per hectare of current grass fields
- Increase fields under intensive grass production (e.g. from fallow, peat lands)
- Traditional usage of grass as feed for ruminants & horses is not increasing - surplus grass available
- When preserved as silage, grass can be biorefined all year around

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The objective of the current work

- To demonstrate silage juice production at farm scale
- To assess the palatability of silage juice with
  - Growing pigs
  - Lactating dairy cows

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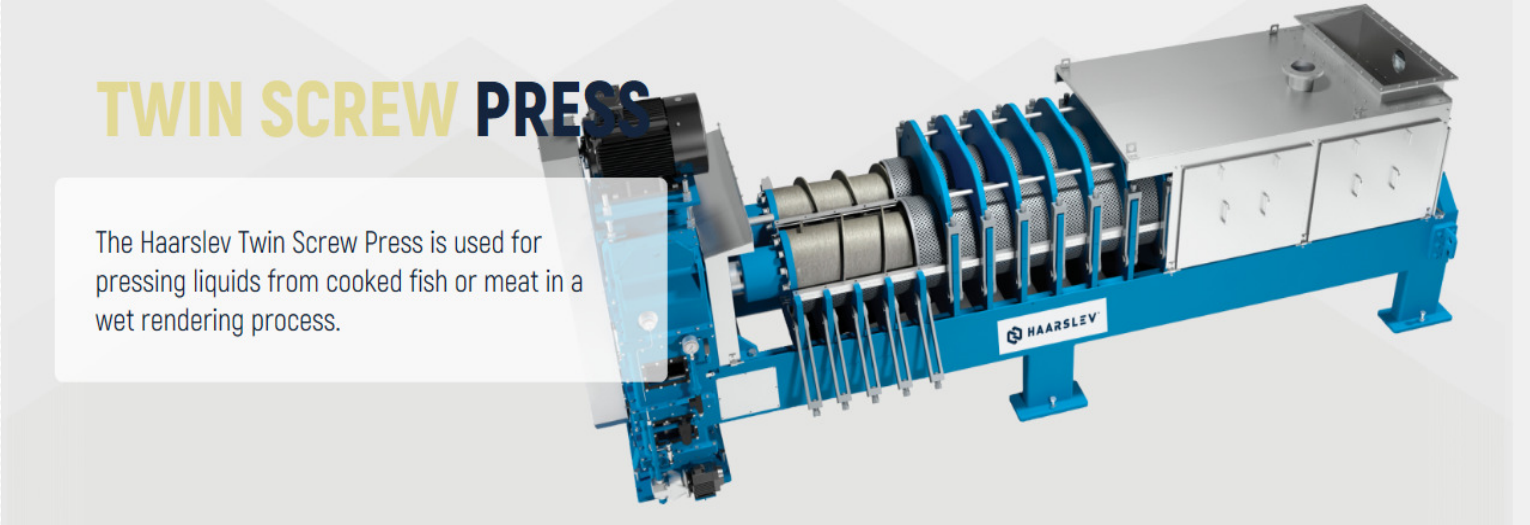
Haarslev Twin Screw Press was used for separating grass silage into solid and liquid fractions



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Silage juice production

Photo: Marketta Rinne / Luke

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Silage juice production was succesful

- The twin screw press performed well with estimated throughput of ≈ 800 kg silage per hour

- The average yields were as follows:
  - Juice proportion (of original silage fresh weight) 488 g/kg
  - DM proportion captured in juice 0.182
  - Ash proportion captured in juice 0.774
  - CP proportion captured in juice 0.575

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Chemical composition of original silage, solid fraction and liquid fraction

	Original silage	Solid fraction	Liquid fraction
Dry matter, g/kg	264	428	100
In dry matter, g/kg			
Ash	102	71	255
Crude protein	126	117	166
NDF	547	645	Nd*
Water soluble carbohydrates	37	18	120
Ethanol	6	2	21
Lactic acid	55	25	183
Acetic acid	21	9	65
Propionic acid	0.5	0.3	0
Butyric acid	0.4	0.2	0.4
In total N, g/kg N			
Soluble N	347	232	Nd*
Ammonium-N	47	23	102
In vitro cellulase solubility	775	739	Nd*

*Not determined. By definition, silage juice is totally soluble.

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Silage juice palatability for pigs – trial set up

- The palatability trial was conducted at a pig farm in spring 2017
- Pig feeding at the farm: wet distillers grains based liquid feed, three times a day
- One pen with 8 pigs was used; weighing 51.9 kg at start and 60.6 kg at the end of the trial.
- Two days adjustment period: first the liquid, then after 15 min pelleted feed to through
- Five days trial period : daily increasing portions of silage juice + standard portion of pelleted feed
- At start 2.6 L, at the end 4.1 L silage juice per pig per day

Photo: Marketta Rinne / Luke

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What did pigs think about grass juice?

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Silage juice palatability for pigs – results

- After tasting pigs refused to eat pure silage juice, but mixture of silage juice and pelleted feed was consumed well
- The planned daily increase of silage juice portions realised
- Small amout of leftovers were found in through 5 times during the 5 day period
  - 3 times during two first days
  - 2 times during three last days

Silage juice palatability for pigs – results

- Faeces softened and became loose from second day of trial onwards
- After the trial the faeces' consistency became normal within two days

Photos: ©Antti Hyppönen

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Silage juice palatability for pigs – results

- Average daily gain of the pigs 1 780 g d^{-1} was very high, generally for fattening pigs it is around 1000 g d^{-1}
- The pelleted feed fed with the silage juice was planned for pigs of 20 - 50 kg live weight -> protein supply for the pigs was higher than recommended (Luke, Feed Tables, 2014)
- Dry matter content of the silage juice was 100 g kg^{-1} -> majority of the protein was from the pelleted feed
- Potassium content of the silage juice is approx. 7 g kg^{-1} (variation in Luke analyses 5.8 – 9.9 g kg^{-1})

Silage juice palatability for pigs – conclusions

- Pigs consume the silage juice well if it is mixed with other feed.
- The organic acids and formic acid (if used as silage additive) may have positive effects in stabilizing the liquid feed and benefit pig intestinal well-being
- The high potassium content of the juice or the high protein content may caused the loose faeces.
- Potassium content of the silage juice is high and may become the limiting factor in using silage juice in large quantity feeding of pigs.

What did cows think about grass juice?

- The experiment was conducted at Luke Minkiö dairy barn in spring 2017 with fresh silage juice
  - The experiment lasted 5 days and no signs of juice instability were noted
- Five cows in individual pens were used
- Feed consumption and milk production was measured daily
- The cows were fed as follows:
  - Water freely
  - *Ad libitum* access to grass silage
  - 8.2 kg DM concentrate per day
  - 20 kg of silage juice per day in two portions


Photo: Marketta Rinne / Luke

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The cows were kept in individual pens to allow measurement of juice intake

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Results from the dairy cow palatability trial

	Silage juice
Cow live weight, kg	692
Days in milk	407
Silage intake, kg dry matter (DM)/d	10.9
Concentrate intake, kg DM/d	8.2
Silage juice intake, kg/d	14.7
Silage juice intake, kg DM/d	1.47
Total DM intake, kg/d	20.6
Milk production, kg/d	21.2
Energy corrected milk, kg/d	28.1

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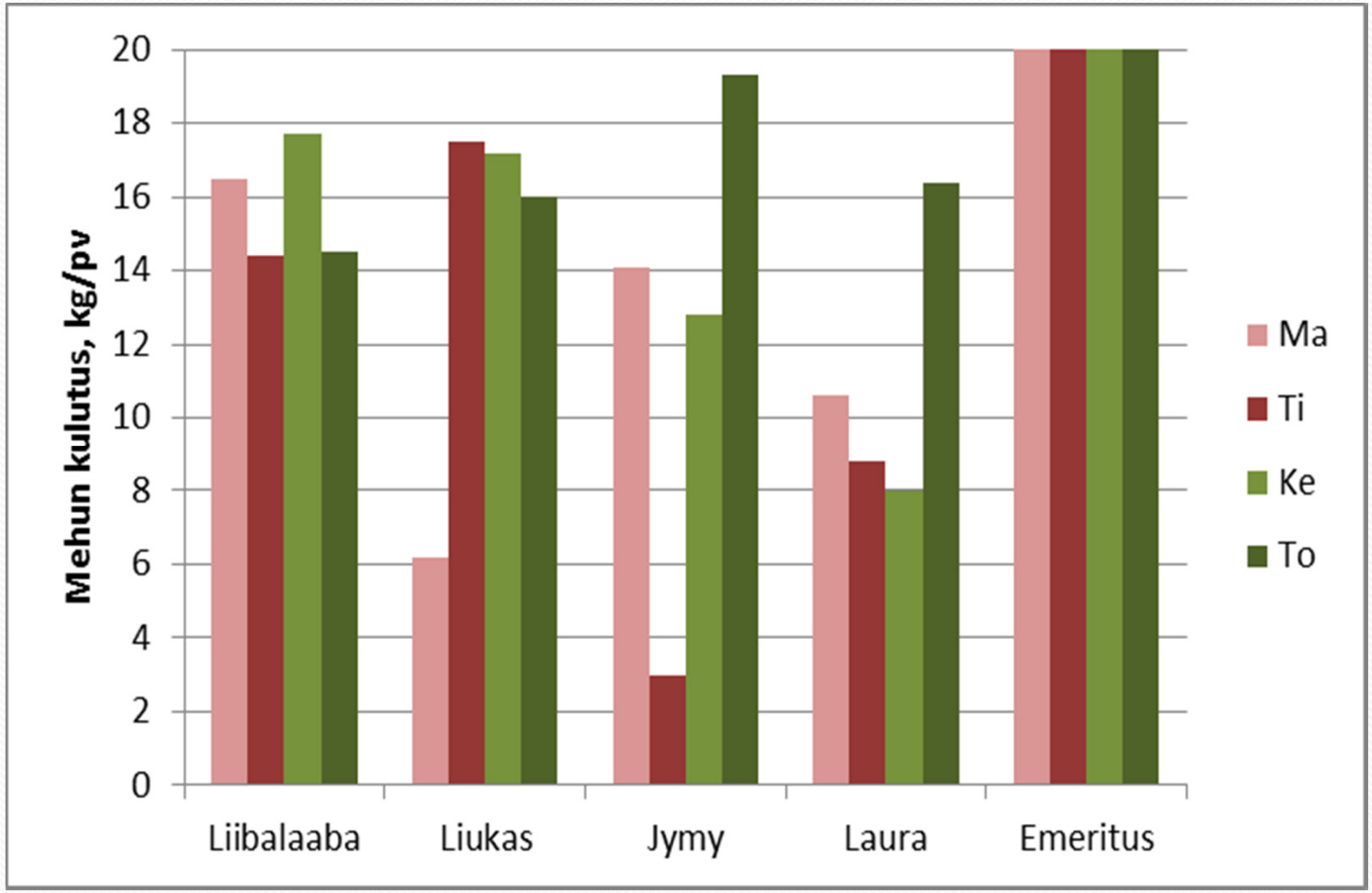
Average silage juice consumption was 14.7 kg/d



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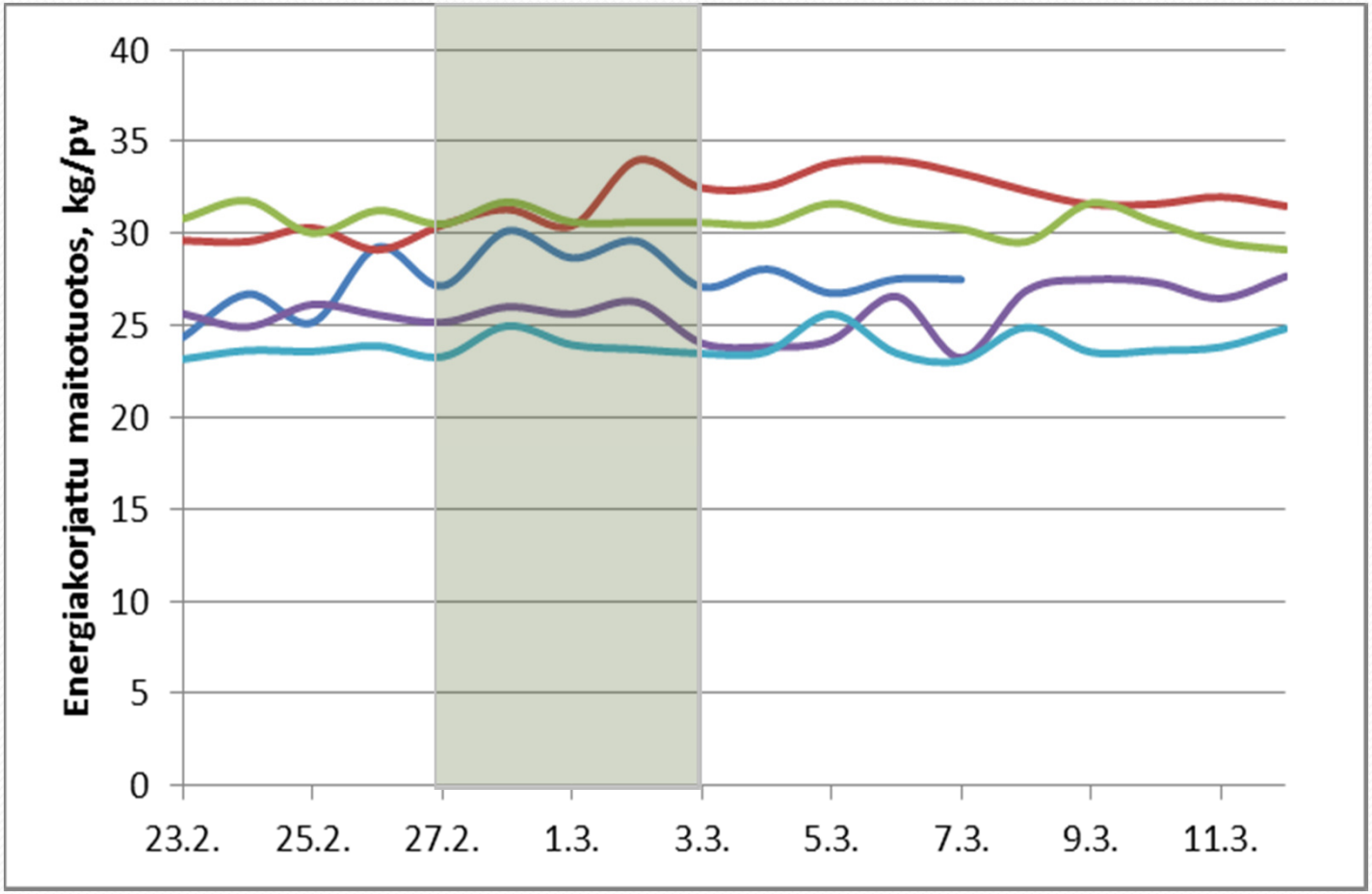
Milk production of individual cows, (shaded area) compared to time before or after the test.



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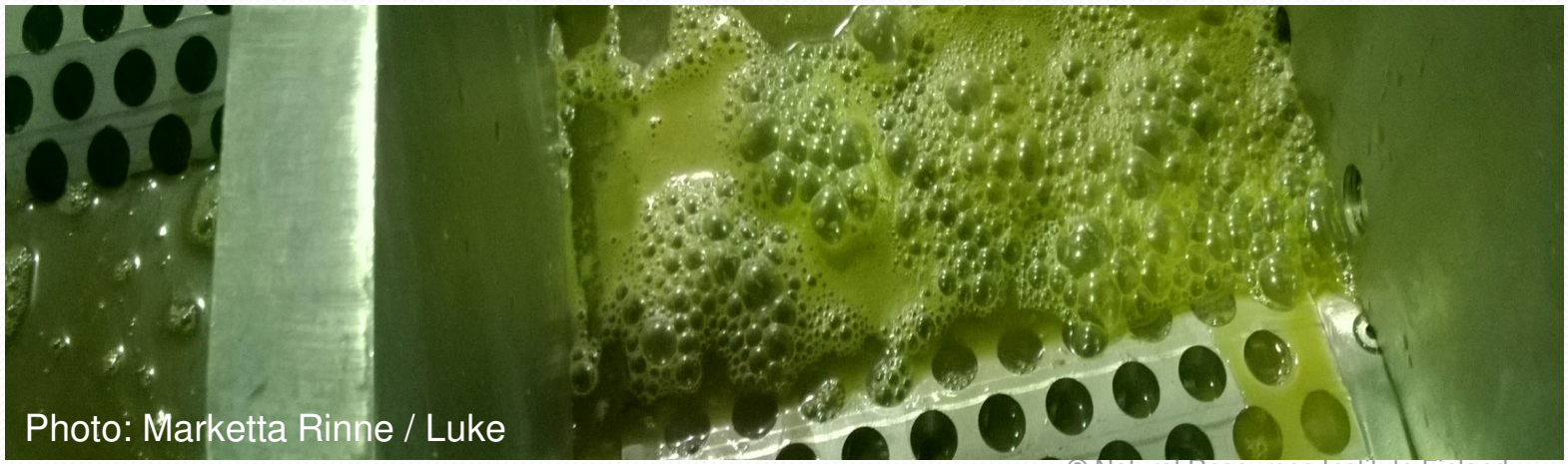
Silage juice could be incorporated into dairy diets without problems

- Silage juice was readily consumed by cows (up to 20 l day was offered)
- The TMR of high producing dairy cows could be fortified by silage juice to increase the amount of on-farm produced grass in the diet
- The soluble components (amino acids, sugars) may partly escape rumen degradation due to fast passage rate in the liquid phase
- The more fibrous press residue could be diverted to dry cows / heifers with lower nutrient requirements



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Main conclusions

- Increase of self sufficiency at farm, regional and national level
- New markets for grass
  - Increased grass cultivation with potential benefits in nutrient use efficiency, soil structure, soil carbon sequestration, biodiversity, improved rural livelihoods
- Possibility of including grass into crop rotation of pig farms
  - Plus possibility to use more manure per hectare than for cereals
- Including grass based products in pig diets increases the proportion non-human edible feeds in their diets
- Grass juice may act as a natural feed component having a positive effects on intestinal health of pigs

Thank you for attention

Questions ?