Novel feeds provide opportunities in the livestock sector

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Competitiveness through feeding

- Feed costs are the major variable costs in milk production
- Novel feeds provide opportunities by
  - broadening the raw material range
  - potentially lower feed costs
  - supporting circular economy
  - certain feeds may have positive effects on animal health or product quality
- Ruminants are particularly efficient in using fibrous by-products
- By-products are traditionally used widely in the livestock sector
Trends that affect livestock feeding

• Climate change progresses
  – New plant species and cultivars can be taken into use

• Bioeconomy plays greater role
  – Animal sector is an important actor in the bioeconomy
  – Linkages in several nodes with biomass utilization and production, adding value

• Pressure to reduce environmental load increases
  – Use of N fixing legumes
  – Nitrogen use efficiency
  – P emissions
  – Climate effects

• Feeding globally increasing population becomes more challenging
  – Food security, food safety, functional effects of foods
  – Ethical questions, animal welfare, vegetarian diets
Trends in dairy cow feeding in Finland according to ProAgria show decreases in hay and pasture use but recently relatively stable (data as feed units until 2007 and in kg dry matter after that)
• Rumen allows cows to use efficiently fibrous by-products and feeds, which are otherwise of low value.

• But on the other hand it is difficult to improve the performance from the bulk feed category to higher levels of the cascade.
Europe needs to improve its self-sufficiency in protein feeding of farm animals

- EU is highly dependent on soya bean imports
  - In Finland, the self-sufficiency of protein supplements for livestock is ≈16%
- Again, thanks to rumen microbial protein production, ruminants are not as dependent on high quality protein supplementation as single-stomached animals
- However, approximately 10% increase in milk production can be expected when basal feeds are optimally supplemented with high-quality plant protein
  - Decision about level of supplementation is an economic question – Cow Compass takes into account the production responses
  - Higher protein supplementation also decreases the nitrogen use efficiency in milk production
For efficient ration formulation, detailed information of various feed batches is required.
Web service www.luke.fi/feedtables
Covers ruminants, swine, poultry, horses and fur animals

- Official principals of calculating feed values as commissioned by the Ministry of Agriculture and Forestry
- Feed Tables
- Nutrient requirements
Novel, reinvented and traditional options are of interest

- Wider use of legumes
- Microbial protein (pekilo etc.)
- Micro algae
- Insects
- By-products from bioenergy production
  - Glycerol from biodiesel production
  - Distillers grains from bioethanol production
- New processes for traditional (e.g. food industry by-products) raw materials
Whole-crop cereal silages

- Small grain cereals can provide an option to maize in the North
- Grain legumes have additional benefits:
  - higher protein content,
  - less dependence from N fertilization

Results from Finland

Novelty is relative: Maize is novel in Finland – and fababean "reinvented"
Warmer climate improves the viability of legumes under Northern European conditions

- New species and varieties can be taken into use
- N fixation benefits from higher soil temperature
- Forage legumes boost forage production and have positive effects on feed intake
- Grain legumes can be used as protein supplements or the whole biomass can be harvested as whole crop silage
Forage legumes - perennial

Alsike clover

Lucerne

Red clover

White clover

Grain legumes - annual

Faba bean

Pea

Blue lupin

White lupin

Pea
Promoting the use of legumes is "politically correct"

- Is a high priority currently in Finland and throughout EU
- Both for the livestock sector and for human nutrition
- We currently have a campaign going on in social media: #papuhaaste www.luke.fi/papuhaaste
- Pig, poultry and fish sectors are in more need of alternative protein feeds compared to cattle – they have their own "biorefinery" in the rumen
The typical biomass used as feed for cattle in Northern Europe is traditionally grass.
Converting wood fibre into edible high value products is a tempting idea!
Digestion of wood-based hemicellulose extracts as screened by in vitro gas production method and verified in vivo using sheep

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The objective of the present study was to evaluate the potential of pressurized hot water extracted hemicellulose fractions from various wood species as feeds for ruminants. In Experiment 1, the fermentability of several hemicellulose extracts was screened using an in vitro gas production method. The samples were extracted from spruce (Picea abies) including mainly galactoglucomannan (GGM), from birch (Betula pendula) consisting mainly of xylan and from larch (Larix sibirica) consisting mainly of arabinogalactan. The GGM and xylan samples were readily fermented by rumen microbes while arabinogalactan was not. Based on the in vitro study, GGM was chosen for an in vivo digestibility trial using sheep, where it was fed at increasing proportions of diet dry matter (0, 47, 94 and 141 g kg⁻¹) in a Latin Square design. The in vivo organic matter digestibility of GGM was relatively low, 0.58, but PHWE extracted hemicellulose has some potential as a feed for ruminants.

Key words: birch, digestibility, larch, pressurized hot water extraction, spruce

But no commercial use – yet...
There is potential to use more grass – and more efficiently

- Developing green biorefineries would allow developing new grass based feed products that would be suitable even for single stomached animals
- Combining bioenergy and feed production
- Efficient utilization of nutrients within the system
  - Feed fractions – manure – digestate – nutrients in soil – plant biomass
Project Innofeed develops the grass silage based green refinery forward

- Novel feed products and business concepts
- Allows to increase grass production which is currently underutilized in some areas including Finland
Fruit and vegetable by-products

- Roughly half of the fruits and vegetables in EU go to waste
  - Losses occur at all steps: Agricultural production, processing, distribution, consumers
- The materials are typically moist and easily spoiled, but with proper management (e.g. ensiling), can successfully be used as animal feed
- Material on this topic particularly for Southern European conditions produced as part of an EU FP7 project SOLIC (www.solidairy.eu)

Tomato waste co-ensiled with cereal straw
A large amount of vegetable and potato by-products also produced in Northern Europe

- Project Sivuhyöty seeks for solutions with particular interest in nutrient circulation
Side streams efficiently into use

- Utililizing side streams and by-products from small scale food produces such as potato and other vegetable processing plants has several opportunities and challenges
  - Legislation
  - Hygienic quality of products
  - Logistics
  - Determination of feed values and production responses
  - Pricing

Karotian porkkanasivuvirtaa.
Kuvat: © Luke / Marketta Rinne
Ensiling using proper techniques may be a useful method to stabilize moist by-products.
We have currently numerous possibilities to produce feeds for farm animals

• The challenge is to make them economically competitive…

http://www.cmegroup.com

Fluctuations in soya bean meal prices in U.S. market
Variable solutions can have local significance
There is a feed for every need!

• The amount and quality of feeds offered to animals have significant effects on feed intake and milk production, which largely dictates the economics of the farm
  – Feed cost is the single largest variable cost in milk production
• Take into account effects that feeds have on animal health and product quality
• Use local strengths
• Be innovative
  – Biorefineries provide potential new opportunities to the feed sector
  – In organic production, feeds need to be certified organic, and consumer acceptance kept in mind
Projects contributing to the results presented

- SOLID (EU FP7), http://farmadvice.solidairy.eu/
- Innofeed (Tekes)
- Valkuaisfoorumi (Regional Council of Häme, ERDF), www.hamk.fi/valkuaisfoorumi
- Sivuhyöty (Ministry of Environment)
- ScenoProt (Finnish Academy), https://www.luke.fi/scenoprot/

- Thank you to coworkers and funders!
Some references

One e-learning topic deals with novel feeds

Check also the Farmers Handbook!

http://farmadvice.solidairy.eu/