Ensiling experiments & TMR feeding challenges

MTT Agrifood Research Finland

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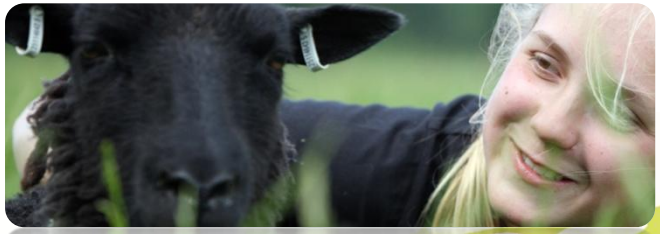
MTT – A strong contributor in the food system

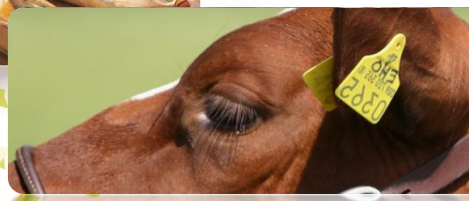
- MTT is a leading **research institute** developing sustainability and competitiveness of the food system.
- We produce and disseminate scientific research information and transfer technology for the entire **agriculture** and **food** sector.
- Our products include innovations and solutions relating to renewable natural resources.
- We impact societal development by providing expert services that broadly serve authorities, society and the research community.
- Our extensive international collaboration network ensures the best possible resources and competence for the benefit of our customers.

Locations and personnel

- MTT has operations in 15 locations around Finland.
- The headquarters is located in Jokioinen, in South-West Häme region.
- MTT employs about 760 persons.
- Researchers and academic experts account for almost half of the personnel.

Solutions for customers in five research areas





RESPONSIBILITY IN THE FOOD SYSTEM

GREEN ECONOMY OPPORTUNITIES

RESPONSIBLE FOOD CHAIN – BETTER CONSUMER WELL-BEING

SUSTAINABLE AND COMPETITIVE FOOD PRODUCTION

ECONOMIC RESPONSIBILITY

PRODUCT SAFETY

NUTRITION

ENVIRONMENT

LOCAL WELL-BEING

OCCUPATIONAL WELFARE

ANIMAL WELFARE

Food industry

Packaging industry

Transportation

Animal production

Retail

Animal feed industry

Consumer

Cultivation

Biomaterials

Energy production

Waste and by-products

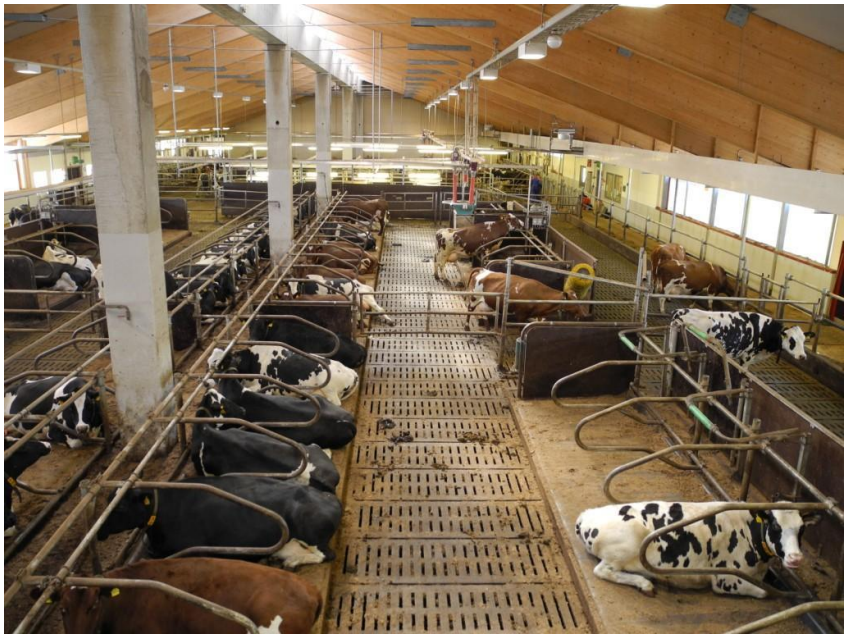
Production input industry

Chemical industry

SMARTLY FROM RENEWABLE RESOURCES

ENVIRONMENTALLY FRIENDLY AGRICULTURE

Infrastructure – a prerequisite for research



Livestock

- 90 bulls
- 230 cows
- 90 sows and 1200 pigs annually
- 2,000 broilers
- 30 horses

Fields, total 1,639 ha

Maaninka research cowshed

- Free-stall for 120 animals and a 12-stall section for individual animals
- Possibility for simultaneous feeding of 3 concentrated feeds from kiosks and 4 different coarse-fodders or mixed fodders
- 24 Insected coarse-fodder s´cales
- Exercise yard equipped with access control gates and the possibility to collect run-off water

Greenhouse production research

Measuring equipment and measuring environments

Biogas research

Genome research facilities

Laboratory services

Ensiling experiments at MTT

Ensiling trial at laboratory scale

On field

- Grass sward typical for Finnish conditions (timothy-meadow fescue-red clover)
- Harvest time tailored according to the target dry matter level and digestibility
- Grass cut using mover-conditioner
- Prewilted
- Precision chopped
- Transported to the laboratory for ensiling

Example: Ensiling trial at laboratory scale

At laboratory

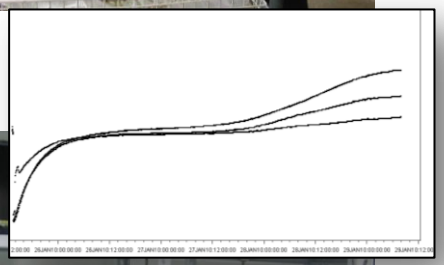
- Grass material sampled for analysing dry matter, ash, nitrogen, fibre (NDF), digestibility (sellulase method), buffering capacity and water soluble carbohydrates
- Additive treatments appliend on separate batches of grass
- Three replicate silos filled for each treatment
- Silos filled to constant density
- Silos closed and a lead plummet and additionally 2 kg water bag added on each silo to press the silage
- Effluent production can be measured
- Losses during ensiling can be measured

Ensiling

- Ensiling time typically 100 days

At silo opening

- Silos weighed, opened and emptied
- Silage from each silo mixed and sampled



Quality parameters of the silages measured

- Counts of aerobic bacteria, yeast and moulds determined
- Fermentation quality: pH, water soluble carbohydrates, lactic acid, ethanol, volatile fatty acids
- Aerobic stability measured from the silages using thermocouple wire and data logger
- The effect of aerobic stability of the silage on the aerobic stability of the TMR prepared from the silage mixing the silage with grain

Reporting and publishing

- Results will be carefully reported to the customer
- The report will include statistical tests of the treatment effects on the silage quality parametres and aerobic stability
- MTT is interested in publishing the results when publishing is in common interest of MTT and the customer

Examples:

Ensiling trials at MTT

Small silos (120ml):

-gas production can be measured during fermentation, fermentation kinetics

- if the amount of material is restricted (e.g. wild oat) or number of silos is high

Medium Silos (12 litre): enough sample for most of the analysis including aerobic stability, effluent production can be measured

Bigger silos: for digestibility trials with sheep

- **Clamp silos 50 000 - 200 000 kg**
  - 2 – 4 treatments
  - animal feeding experiments
- **round bales 500 - 800 kg**


Photo: Eeva Saarisalo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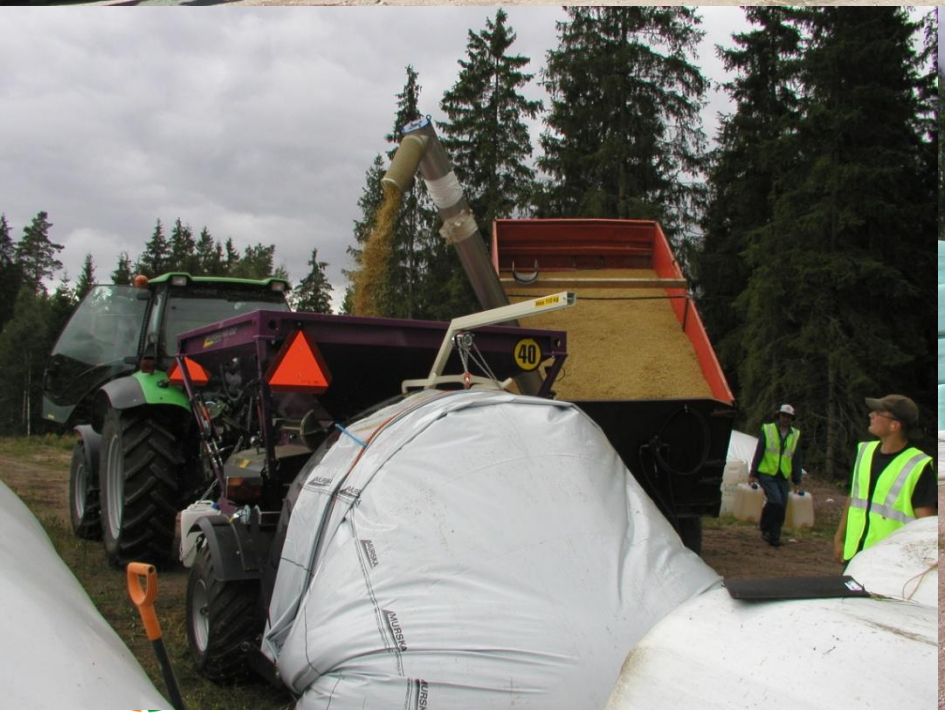
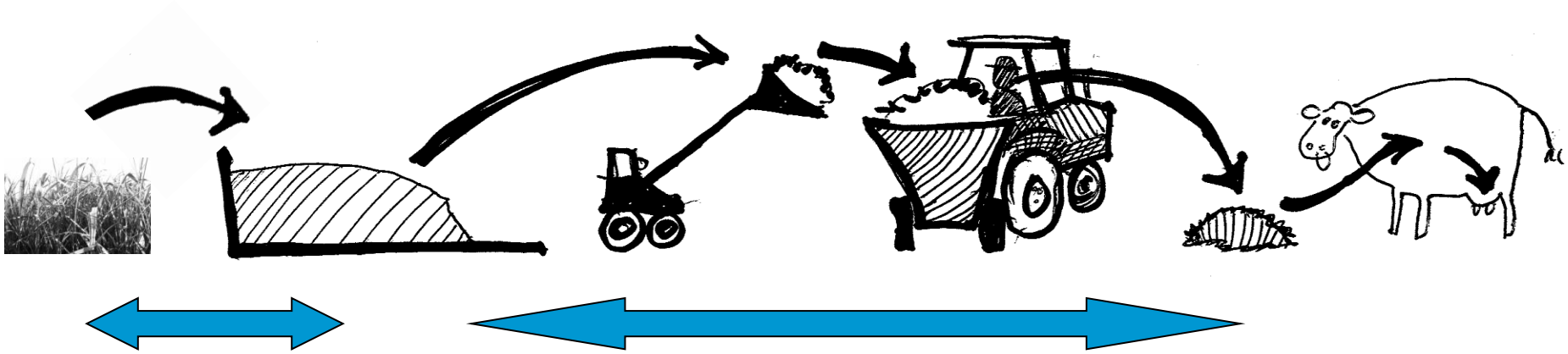
When needed experiments can be conduted in co-operation with local farmers and contractors



In Finland cows are eating good quality silage ensiled with additives

- Nearly half of the dry matter eaten by dairy cows comes from grass silage
- 85 % of the silages are ensiled using additive, most common formic acid based additive
- 90 % of the silage samples (25000 yearly) analysed in Valio laboratory had NH_3-N under 80 g/kg total N

However, sometimes due to aerobic spoilage the good quality is lost before the feed is eaten



- Optimum cutting date
- Best use of additives

- Hygienic quality of the TMR feed in the feed bunk
- Environmental and hygienic aspects related to feed storage and feed logistics on the farm yard

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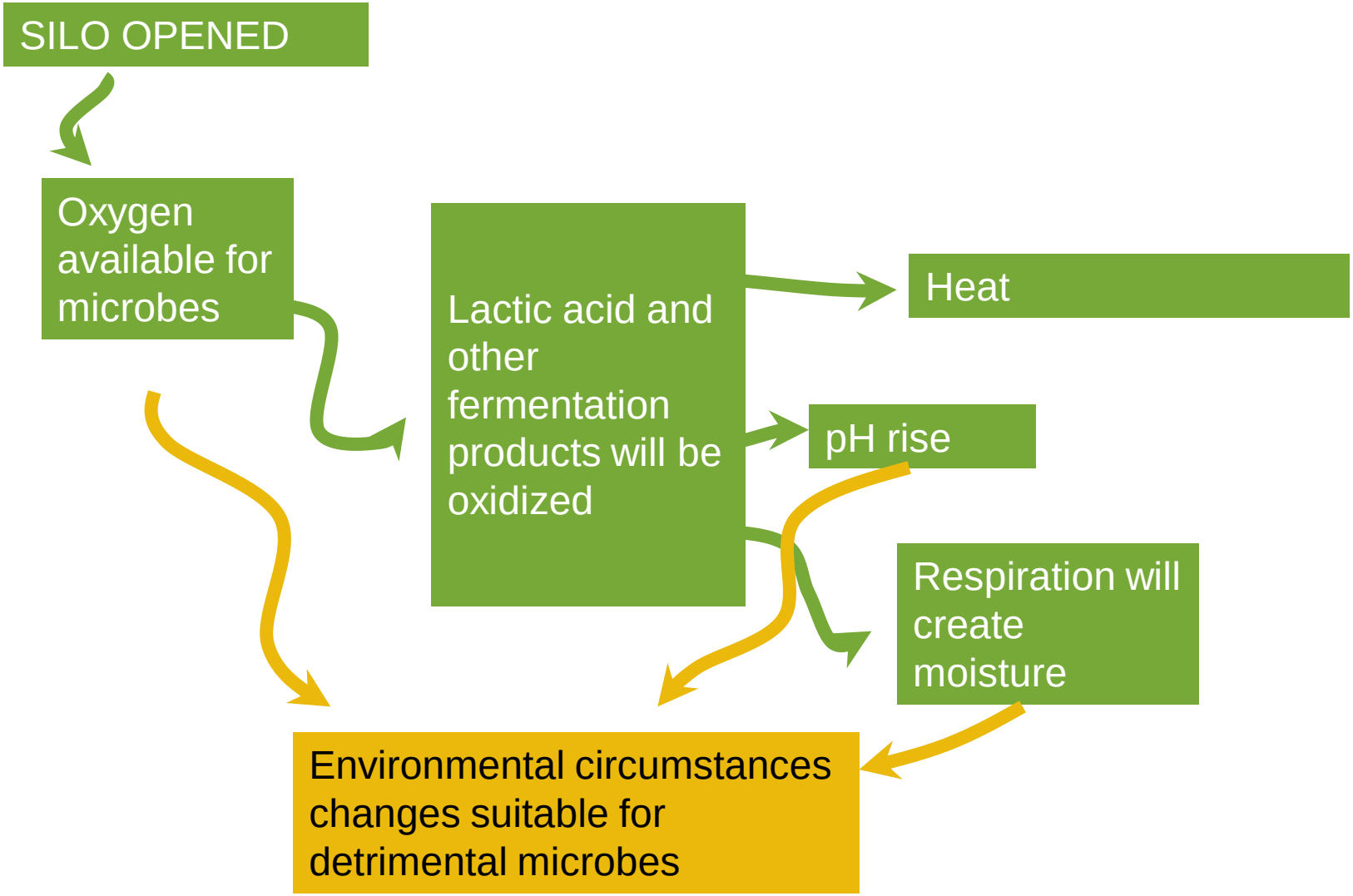

Heating process of feed is emphasized with TMR feeding

in TMR circumstances suitable for microbes:

- Not too acidic,
- some moisture,
- Lots of oxygen
- Highly digestible nutrients

+ temperatur

YEASTS

AEROBIC BACTERIA

MOULDS

Some carbohydrates and organic acids will be oxidised

Temperature rises

Nutrient losses

Mykotoksins

Palatability will be reduced

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Kuva: Arja Seppälä

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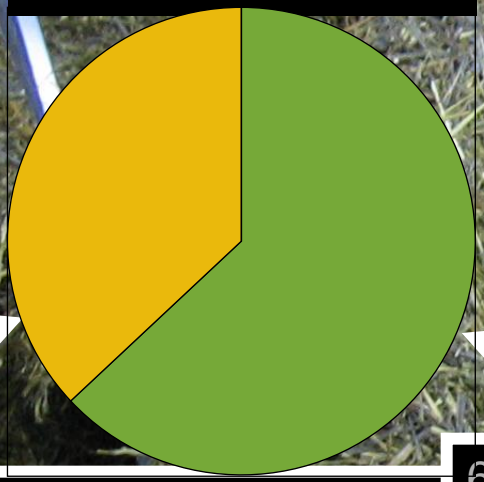
REDROCK


0288
0254

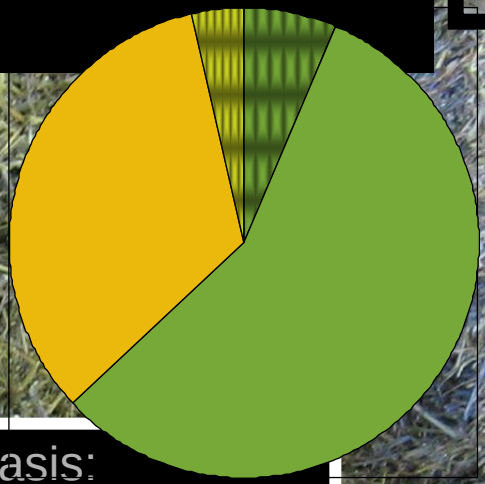
Two total mixed rations

All fresh raw materials



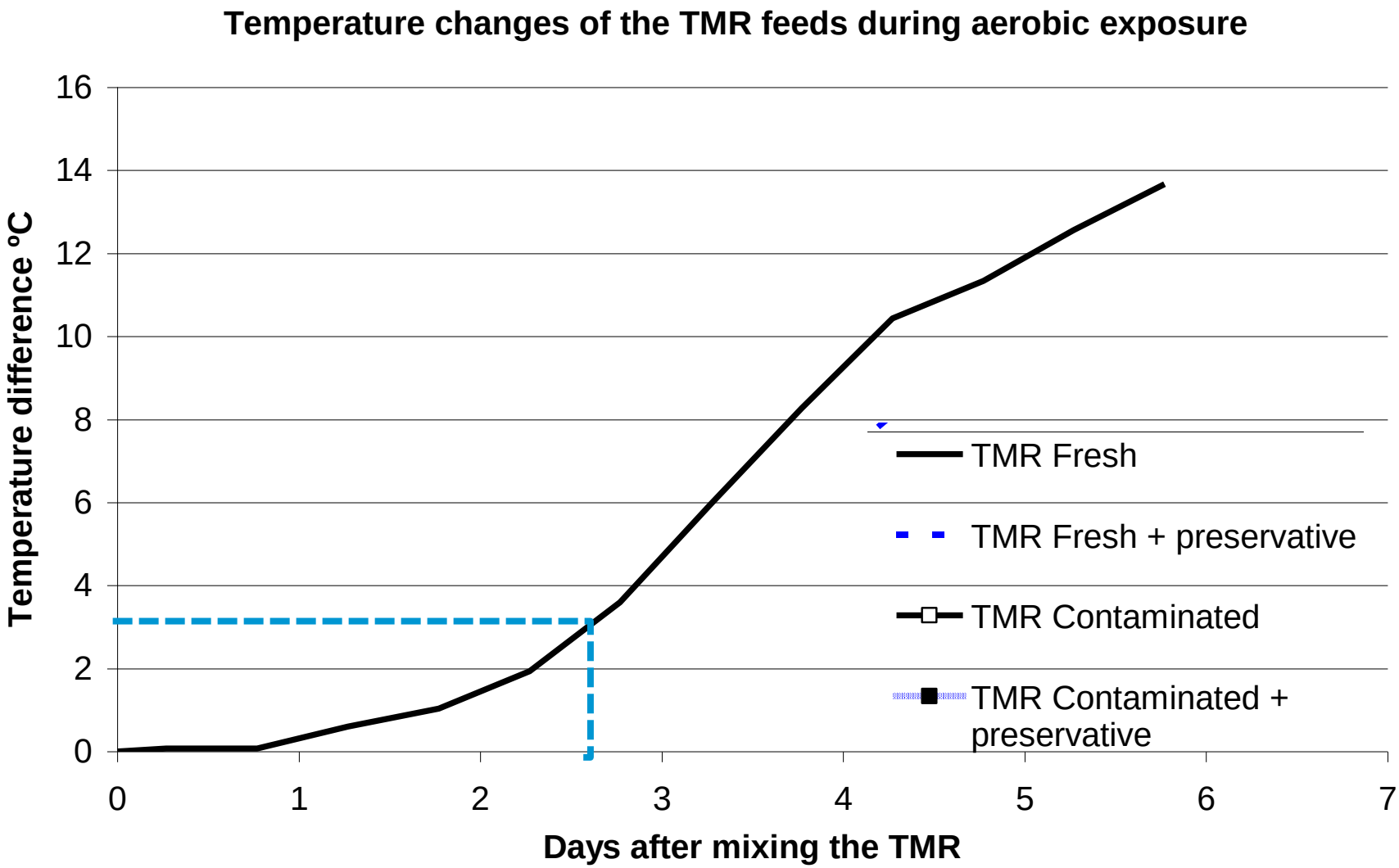
370 g kg-1 on DM basis: pelleted concentrate, barley, oats, molassed sugar beet pulp, rapeseed meal and minerals in proportions of 30:30:11:26:3.

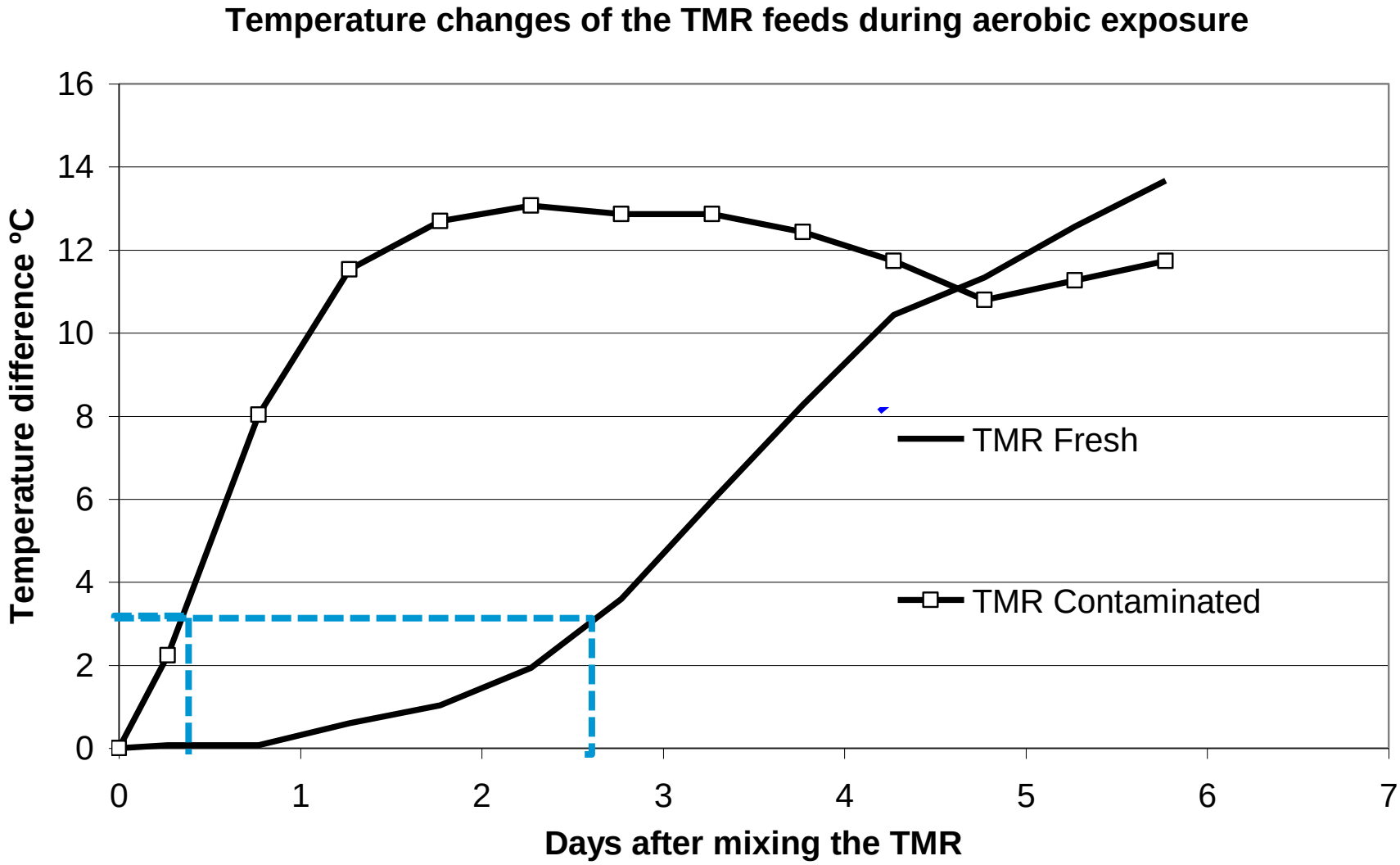
Same recipe, but 10 % inclusion of one week old TMR



630 g kg-1 on DM basis: Good quality grass silage (regrowth of timothy – meadow fescue – red clover, prewilted using formic acid based silage additive), DM: 315 g kg-1, pH 4.15

Dry matter content of the TMR feeds 40 %





The aerobic stability of TMR was reduced from 66 hours to 9 hours by contamination with a 10 % inclusion of spoiled TMR (*P<0.001*).

Removal of all leftovers from the machinery and the feed bunk is one crucial step in quality control of TMR feeding.

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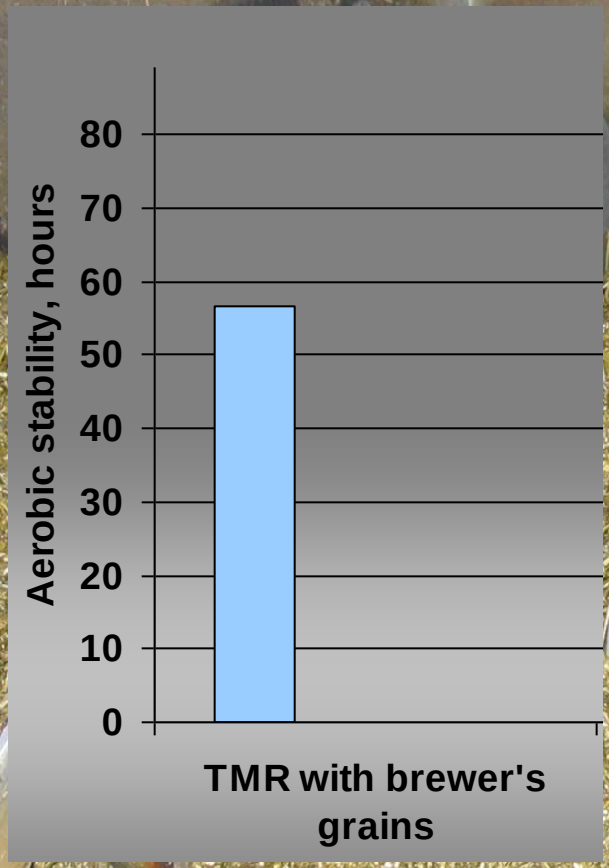

Component	Proportion in DM, %
Rapeseed meal	14
Barley and oats + minerals mixture	24
Brewer’s grains	13
Grass silage	49

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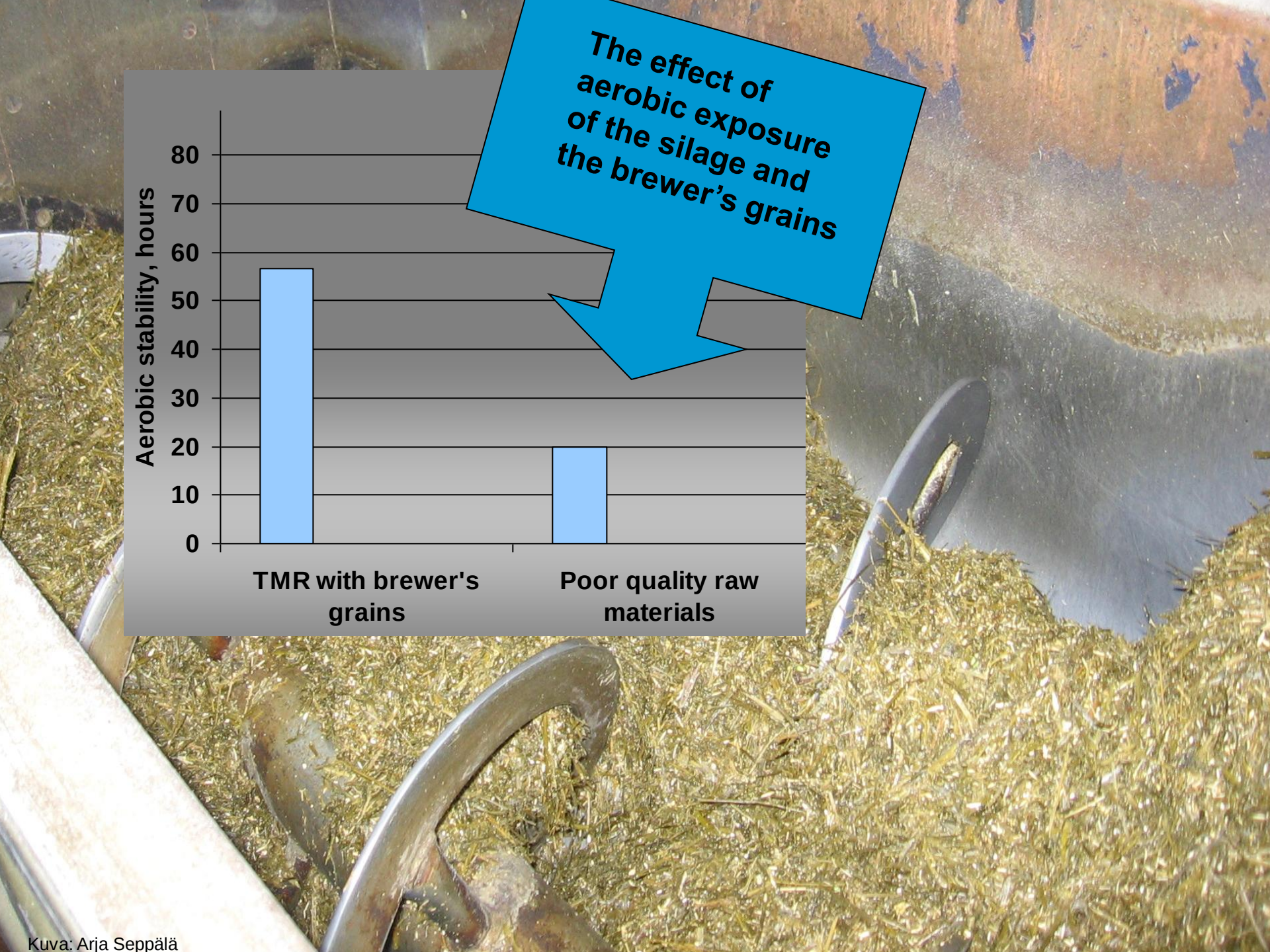

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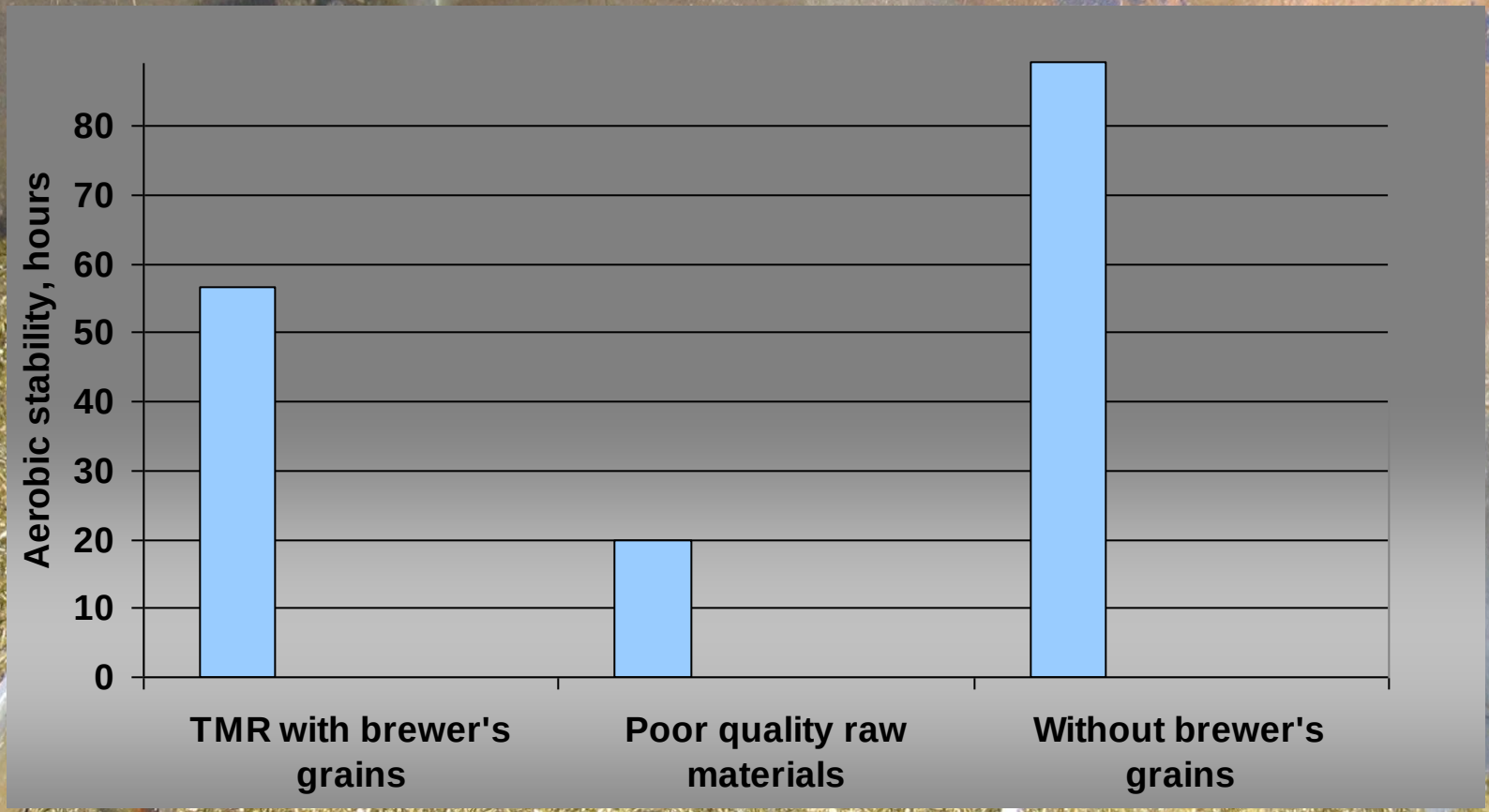

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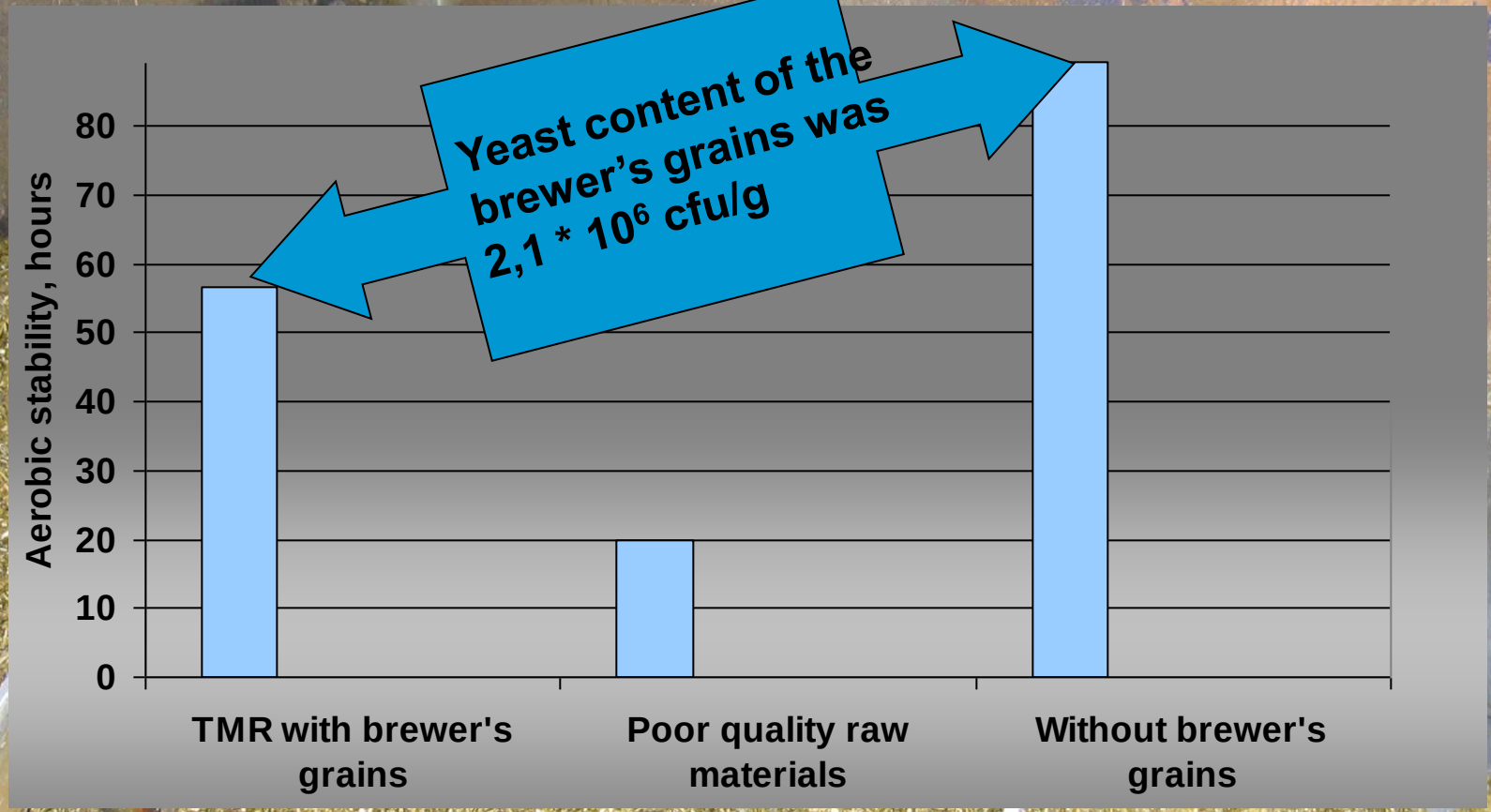

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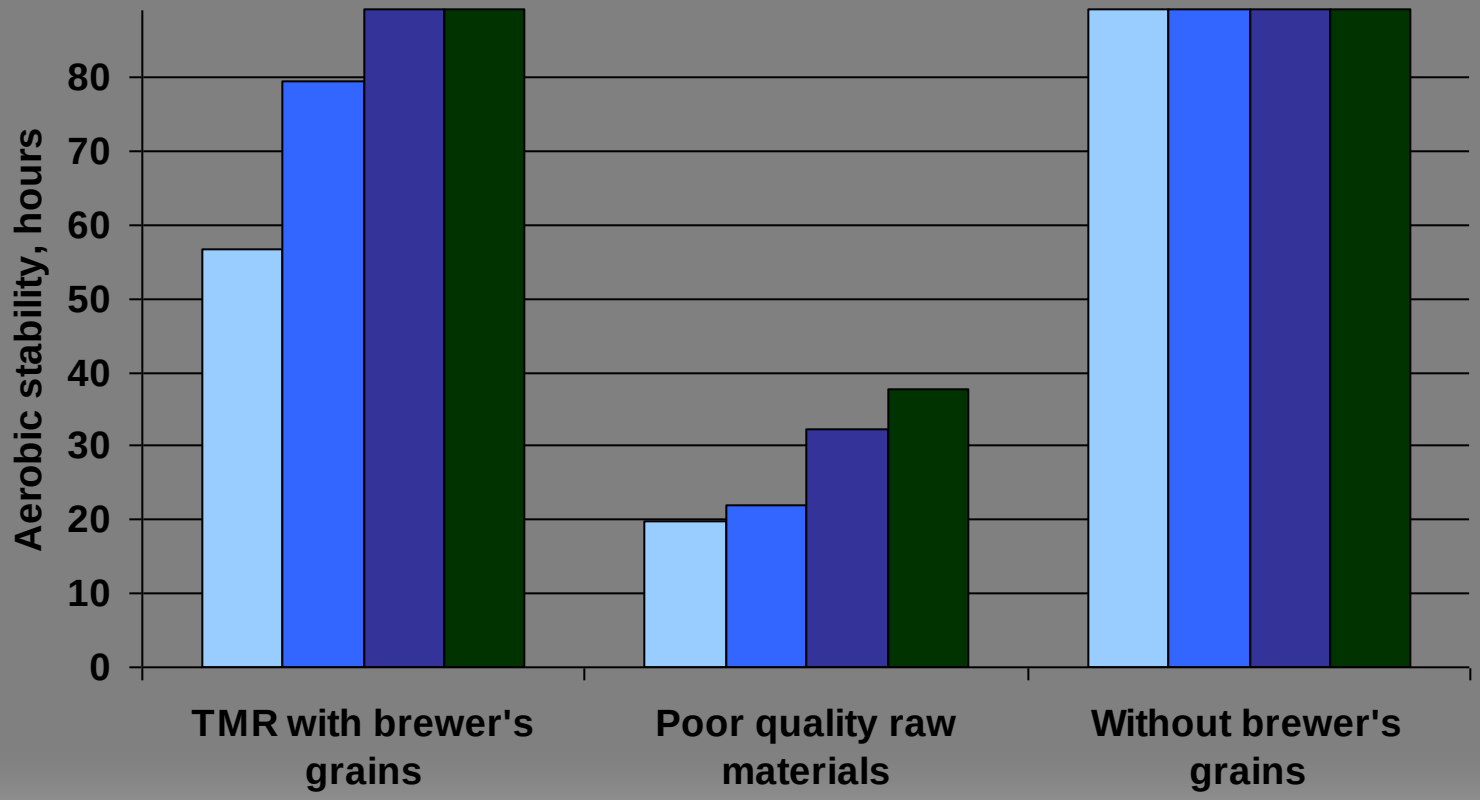

kemira

Stabilizer TMR L

Propionic acid (38,0 %)
Formic acid (27,2 %)
Ammoniumformiate (16,3 %)
Water (18,5 %)

Kuva: Arja Seppälä

Ensiling crimped barley grain at farm scale in plastic tube bag with formic and propionic acid based additives

•Fully ripe spring barley, dry matter between 720 and 840 g/kg.

•barley was crimped and bagged in a plastic tube bag using a Murska 1400 s2x2 roller mill.

• Additives were applied immediately after crimping in the discharge auger of the mill in random order.

•The applied chemical additives (Kemira Oyj) were

- •a formic acid based additive FA: 590 formic acid, 200 propionic acid, 45 ammonium formate, 25 benzoic acid/sorbate and 140 water g/kg)
- •A propionic acid based additive (PA: 726 propionic acid, 214 ammonium propionate and 60 water g/kg).

•The doses were 0, 3, 6 and 9 litres per ton of grain (wet basis) of both additives.


Kemira


6.3.2013


MURSKA


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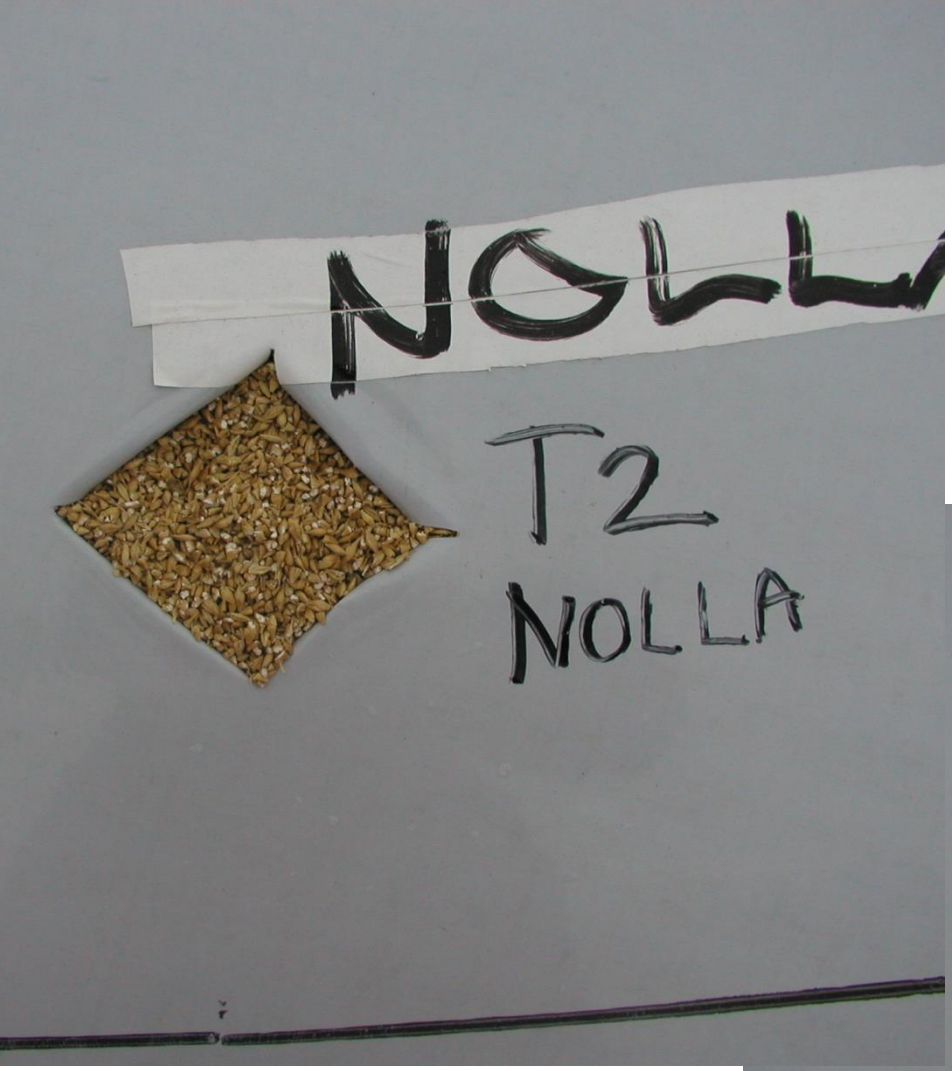

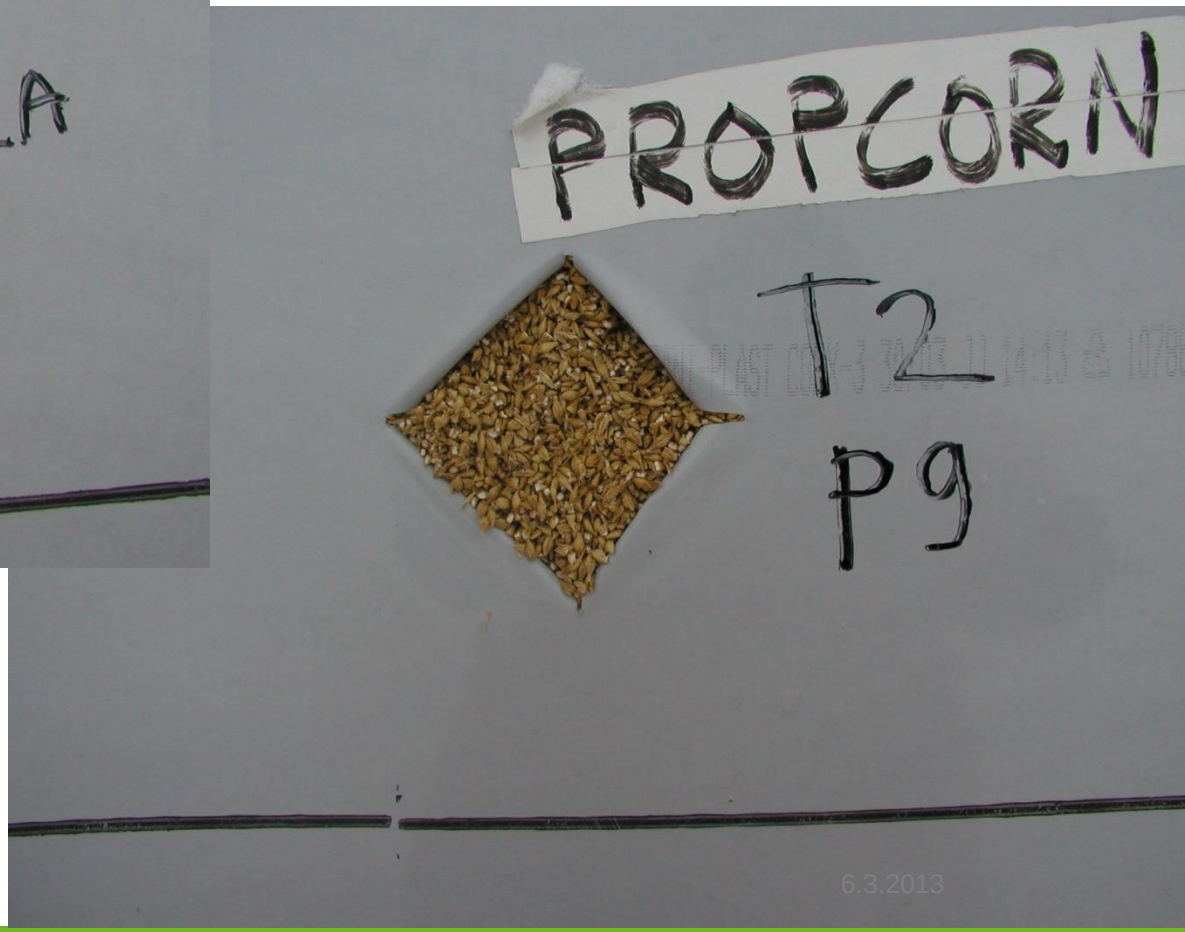

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Most (16/18) of the grain samples ensiled with additive had low numbers of aerobic bacteria, yeast and moulds

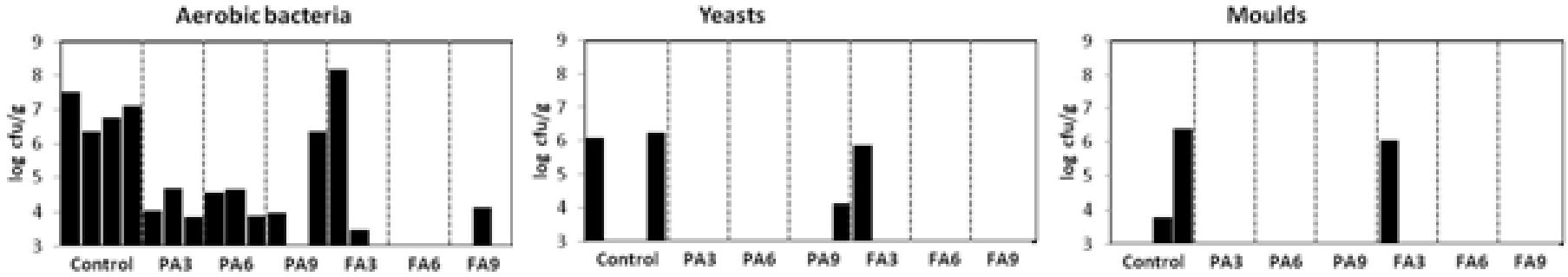
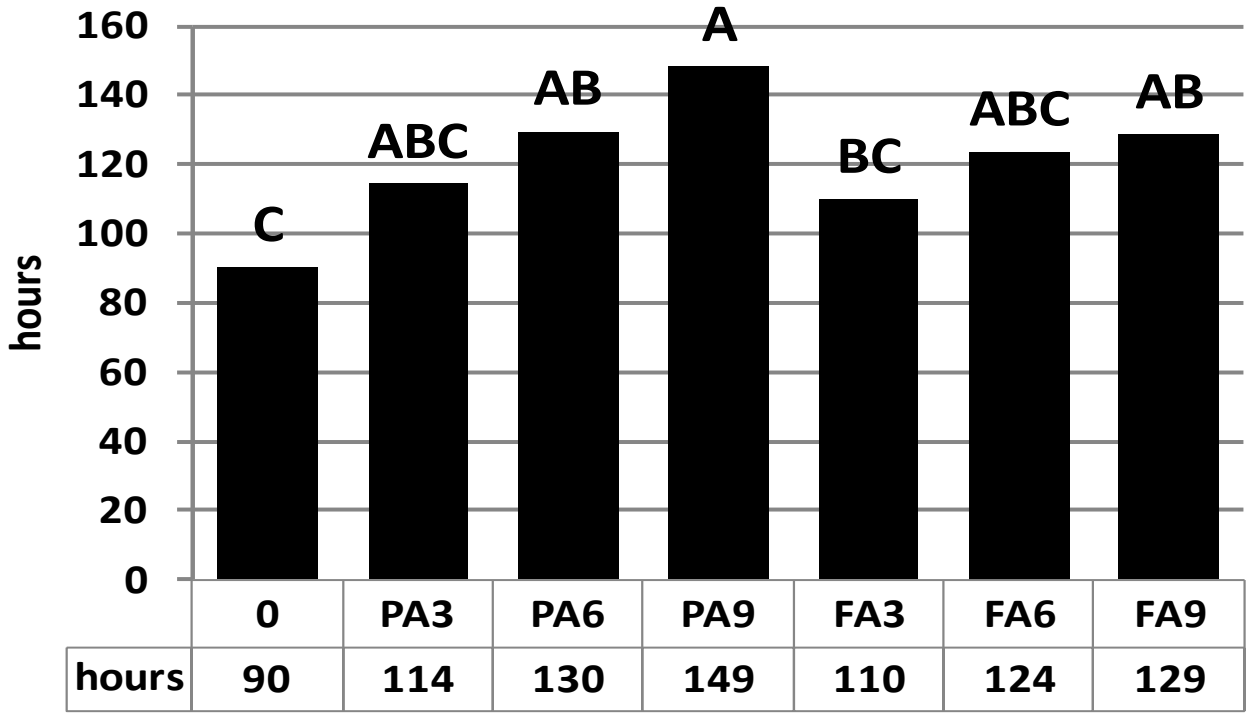


Figure 1. Microbial counts of the crimped barley after ensiling. Each bar within a column represents one replicate.

Aerobic stability of TMR prepared from grass silage and crimped ensiled barley.



	0	PA3	PA6	PA9	FA3	FA6	FA9
hours	90	114	130	149	110	124	129

Treatments, Numbers refer to the dosage level l/ton crimped grain.

- PA: 726 propionic acid, 214 ammonium propionate and 60 water g/kg
- FA: 590 formic acid, 200 propionic acid, 45 ammonium formate, 25 benzoic acid/sorbate and 140 water g/kg

Differences between columns without the same superscript are statistically significant ($p<0.05$, Tukey test).

Additives on crimped grain having moisture 16-28%

- Additives increased aerobic stability of TMR by 20 to 60 hours .
- the application levels of acids were low (0.6-1.8 l/t TMR) compared to effective application levels of TMR stabilisers (> 2 l/t TMR).

- Thus additive application to the crimped barley prior ensiling would be a cost-effective way to control heating of TMR.

References:

- Seppälä, A., Heikkilä, T., Mäki, M., Miettinen, H., Rinne, M. 2013. Controlling aerobic stability of grass silage-based total mixed rations. *Animal feed science and technology* : 179 (2013) 54– 60

- Seppälä, A., Nysand, M., Mäki, M., Miettinen, H., Rinne, M. 2012. Ensiling crimped barley grain at farm scale in plastic tube bag with formic and propionic acid based additives. In: *Proceedings of the XVI international silage conference Hämeenlinna*, Finland, 2-4 July 2012 / Edited by K.Kuoppala, M.Rinne and A.Vanhatalo. Jokioinen, Helsinki: MTT Agrifood Research Finland, University of Helsinki. p. 436-437. [Url]

Kuva: Kalle Saastamoinen