



The role of grass silage in Finland Ensiling experiments in MTT

Arja Seppälä

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 $\text{NH}_3\text{-N}$ under 80 g/kg total N

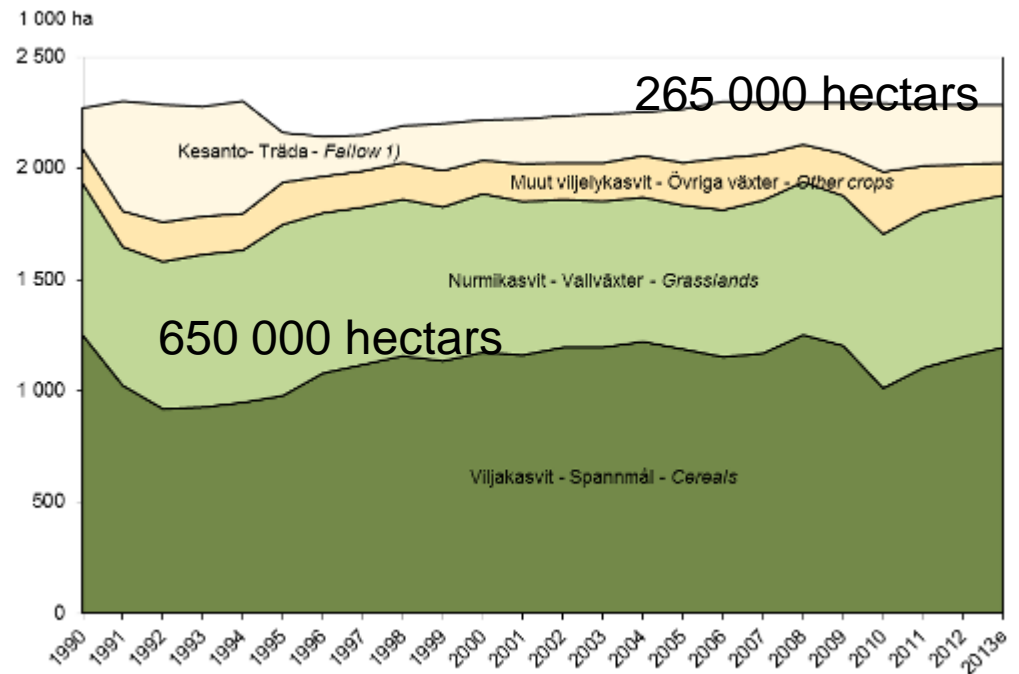


Why grass silage and its quality has such a big role in dairy cow feeding in Finland ?

- long winter,
- during short summer the growth rate of grass vary greatly-effective pasture feeding is typically difficult to arrange
- Maize typically does not mature here
- High price of new dairy barns – the high producing cow will pay the investment back
- Relatively high labor cost – per unit of time worked in the barn the high producing cow gives higher incomes
- -> we can't afford low production level. High production level per cow is especially important for farms that have been investing recently

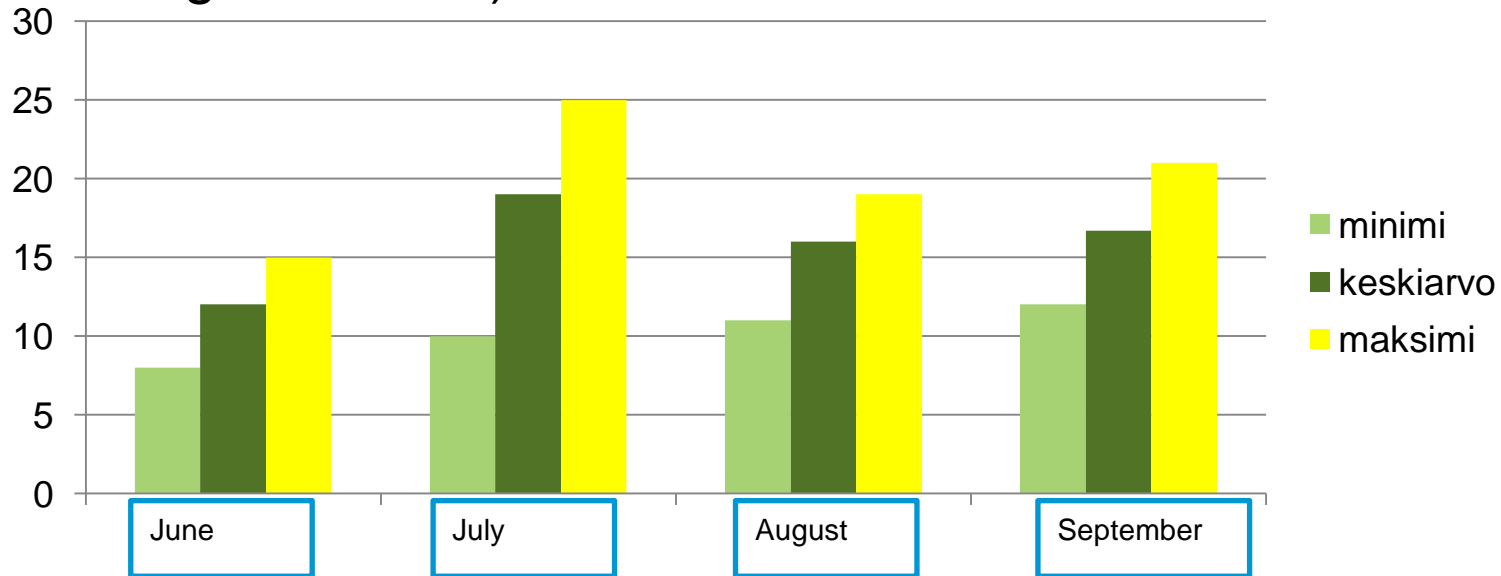
Grasslands in Finland

- Intensive grass silage production is centralized close to dairy herds as well other cattle farms
- Under intensive cultivation the silage yield per hectare is up to 7000 to 9000 kd DM/ha from two to three cuts altogether
- Meanwhile there is plenty of other grasslands that are cultivated quite extensively and maybe harvested only once per summer



Short and busy summer

- Number of sunny days in Piikkiö 2005-2011 which are suitable for silage harvesting (in the beginning of June there is nothing to harvest)



- Meanwhile silage digestibility typically is rapidly decreasing especially in the first cut - the number of optimal days is only about 5 in June!



In practise: the farmer should harvest half of the total feeds (grass silage) in ten days !

- Meanwhile it is known that low digestibility can only partially be compensated by concentrates - and as the concentrate level in the feeding of the animals is already high there is typically not much flexibility.
- Intensive silage production in centralized close to dairy barns on good fields with the target of high yield and high quality both in digestibility and fermentation quality



Ensiling experiments at MTT

Arja Seppälä



Photo: Eeva Saarisalo



Photo: Eeva Saarisalo

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 (cellulase method), buffering capacity and water soluble carbohydrates
- Additive treatments applied 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

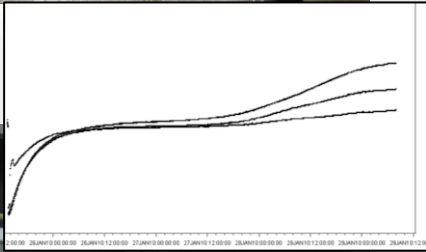
- Silos weighed, opened and emptied
- Silage from each silo mixed and sampled





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 parameters 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**



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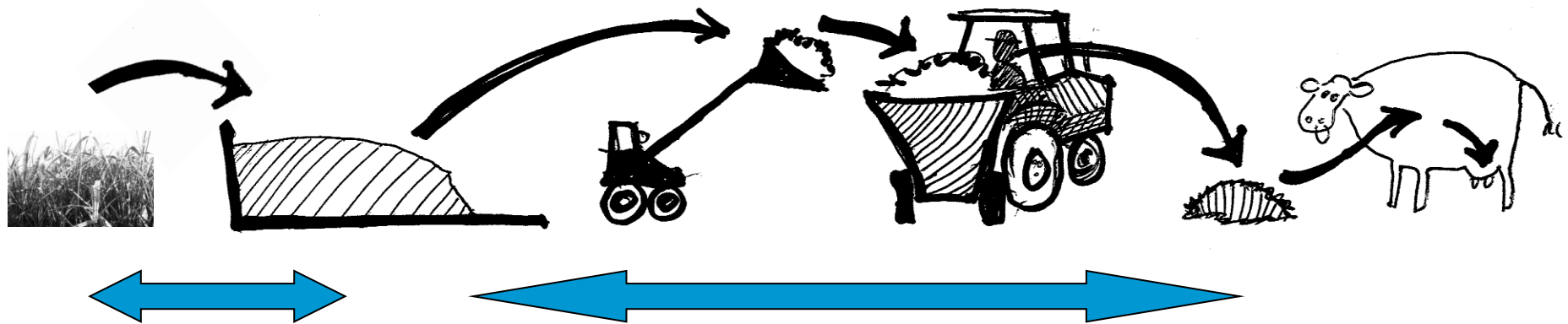




When needed experiments can be conducted in co-operation with local farmers and contractors

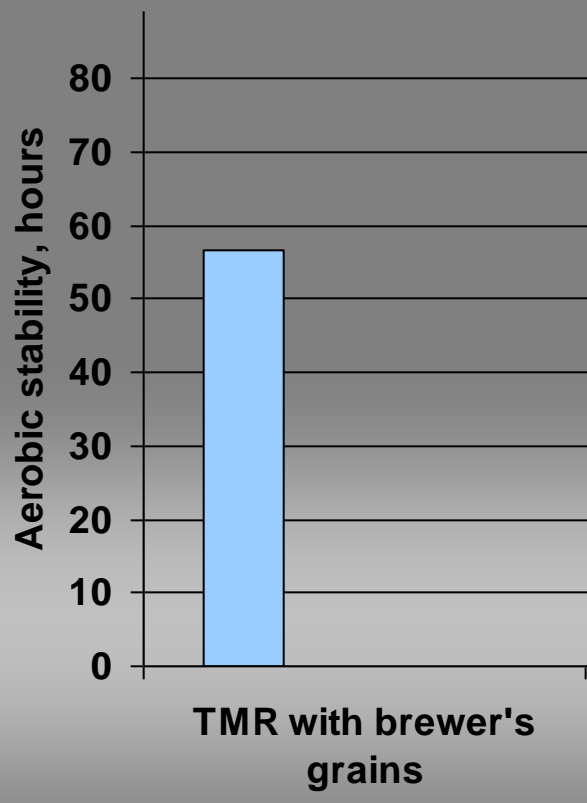


However, sometimes due to aerobic spoilage the good quality is lost before the feed is eaten

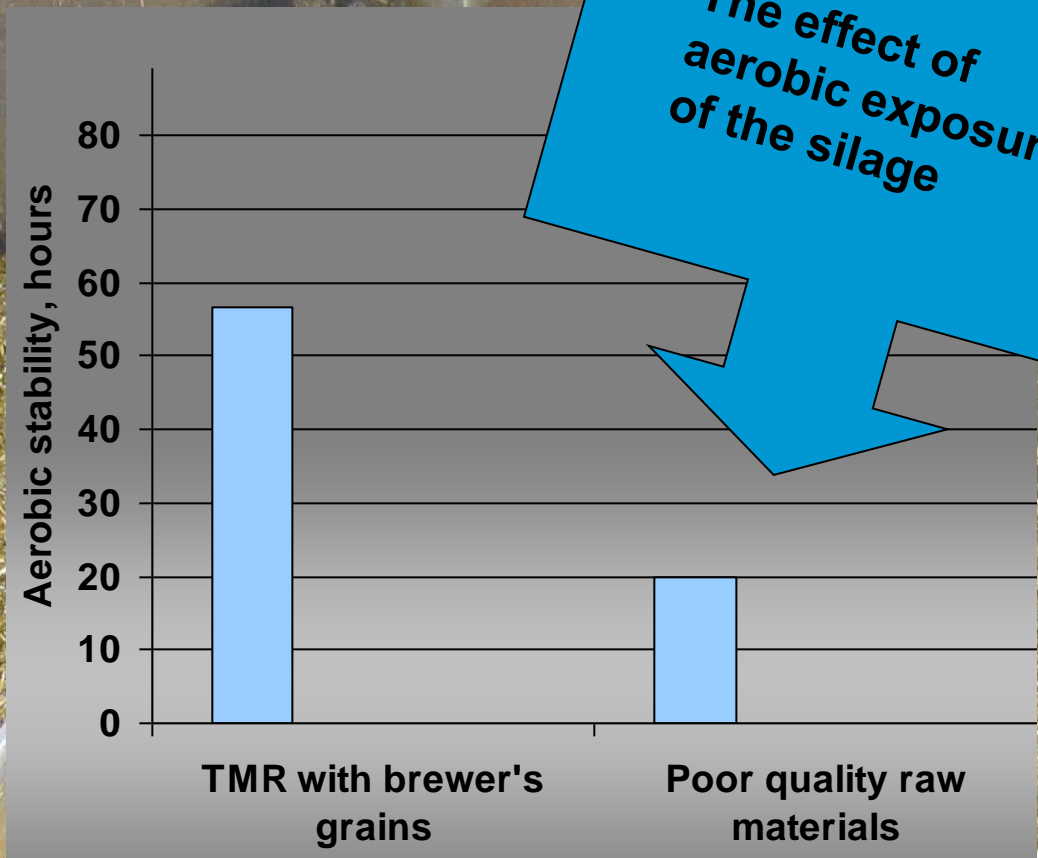


- Optimum cutting date
- Best use of additives

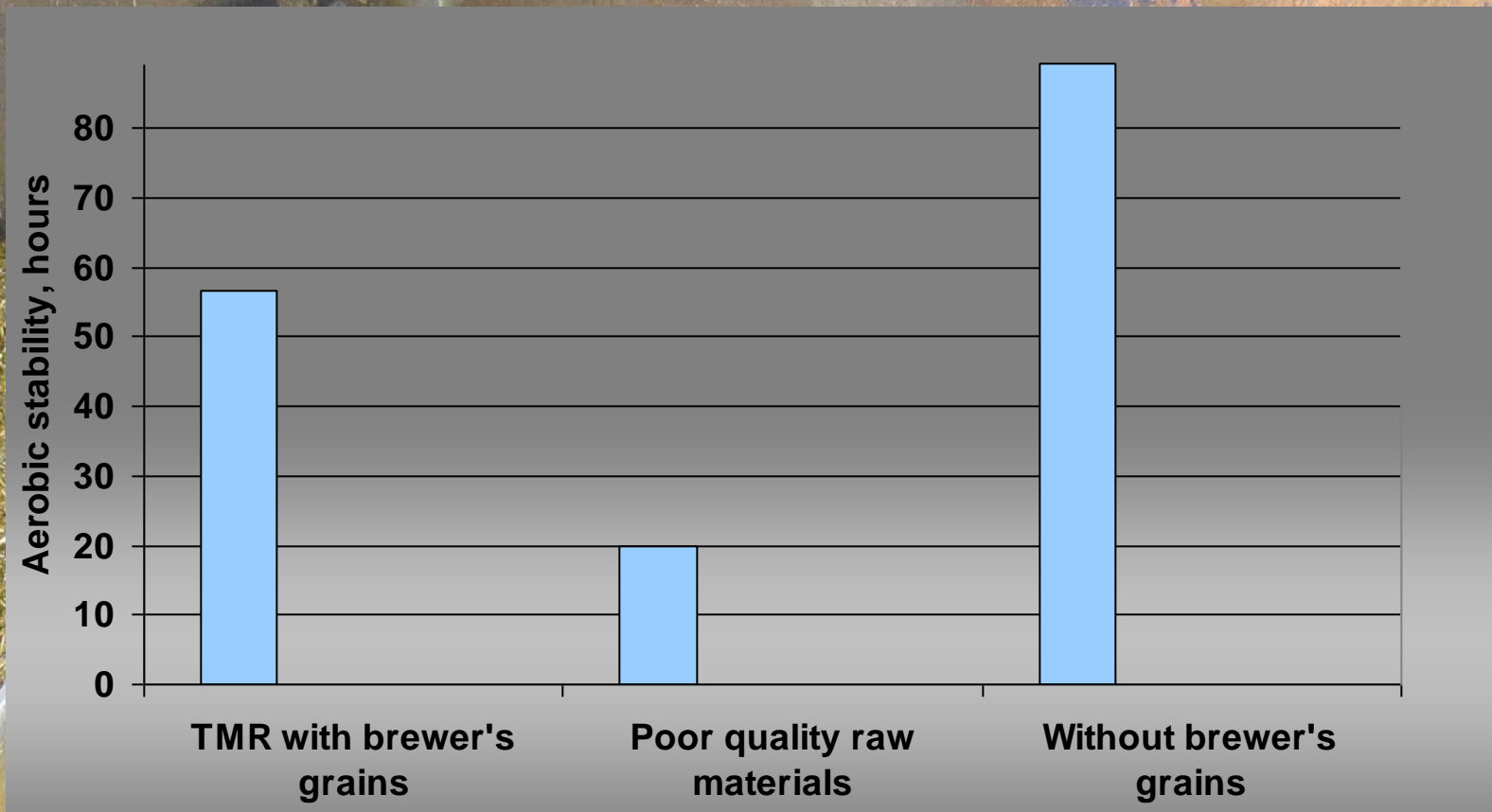
- Hygienic quality of the TMR feed in the feed bunk
- Environmental and hygienic aspects related to feed storage and feed logistics on the farm yard

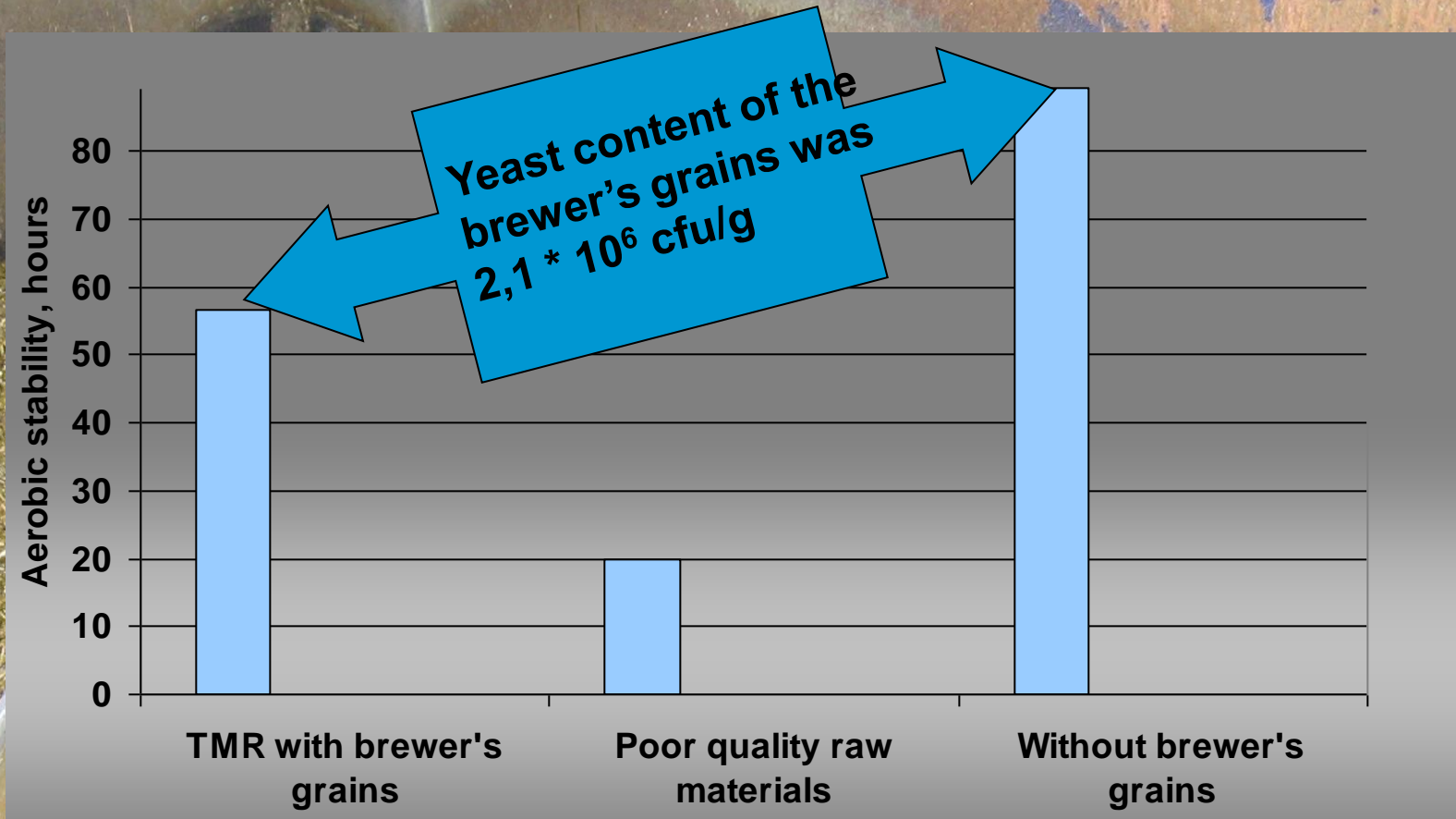


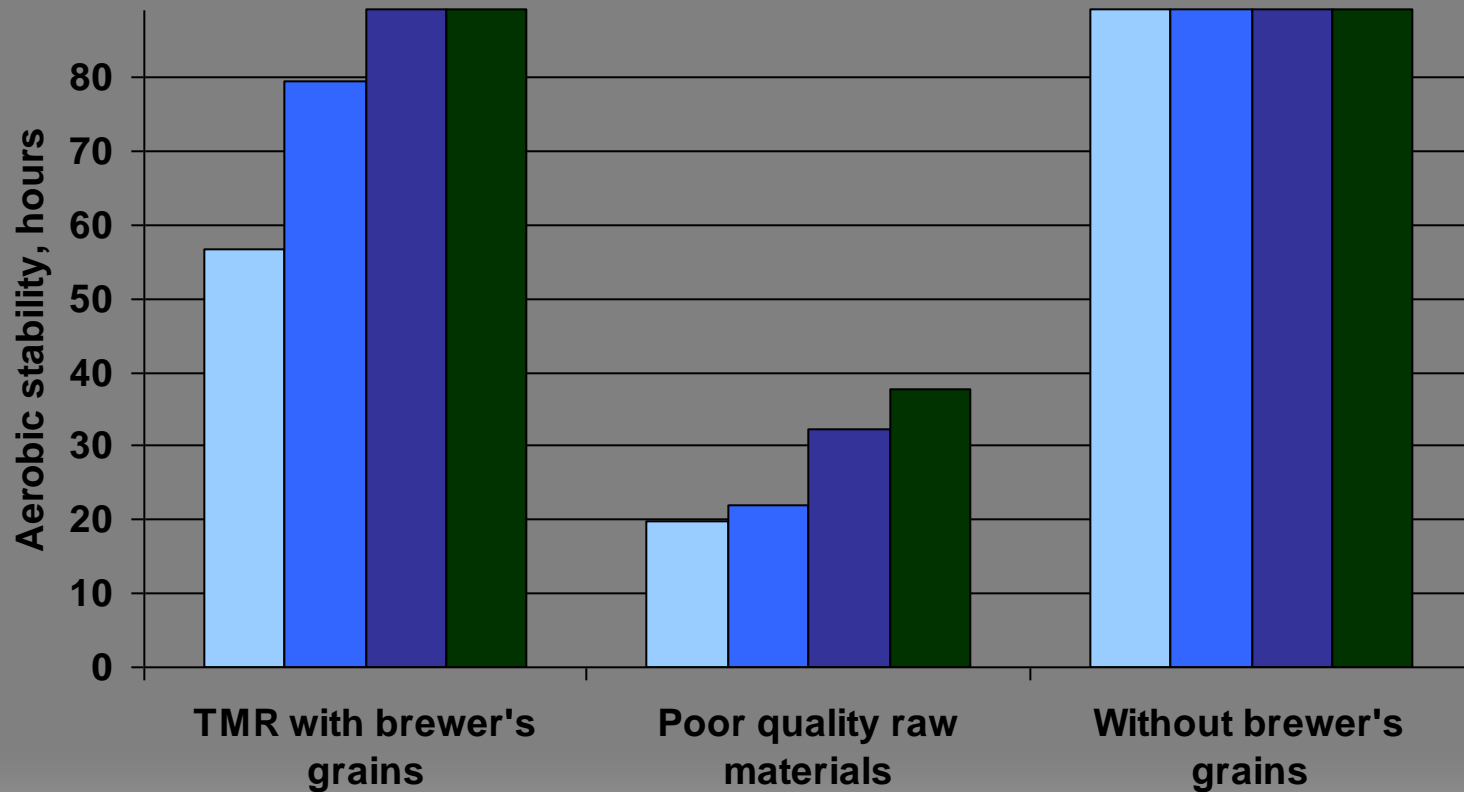
Component	Proportion in DM, %
Rapeseed meal	14
Barley and oats + minerals mixture	24
Brewer's grains	13
Grass silage	49



The effect of aerobic exposure of the silage







Stabilizer TMR L

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

Kemira

- TMR without preservatives
- Stabilizer TMR L 2g/kg
- Stabilizer TMR L 4g/kg
- Stabilizer TMR L 6g/kg

Ensiling crimped high moisture barley with different additives



Dry matter content 605 g/kg

Additive treatments

Control



Biotol
Biocrimp



*Pediococcus
pentosaceus*
NCIMB 12455,
*Lactobacillus
buchneri* NCIMB
40788

Kemira
Aiv 2000
Plus 3 l/t

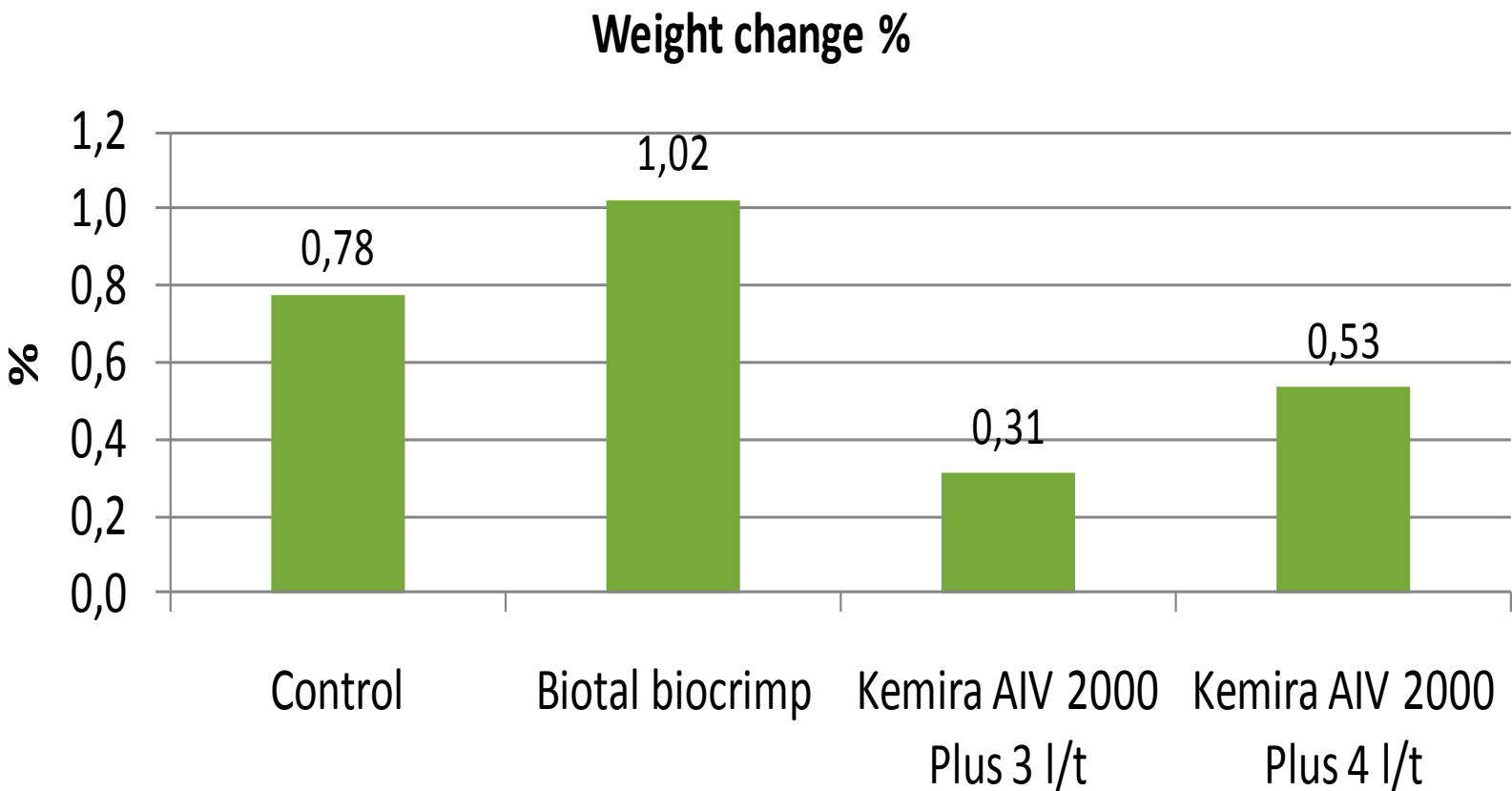


Kemira
Aiv 2000
Plus 4 l/t

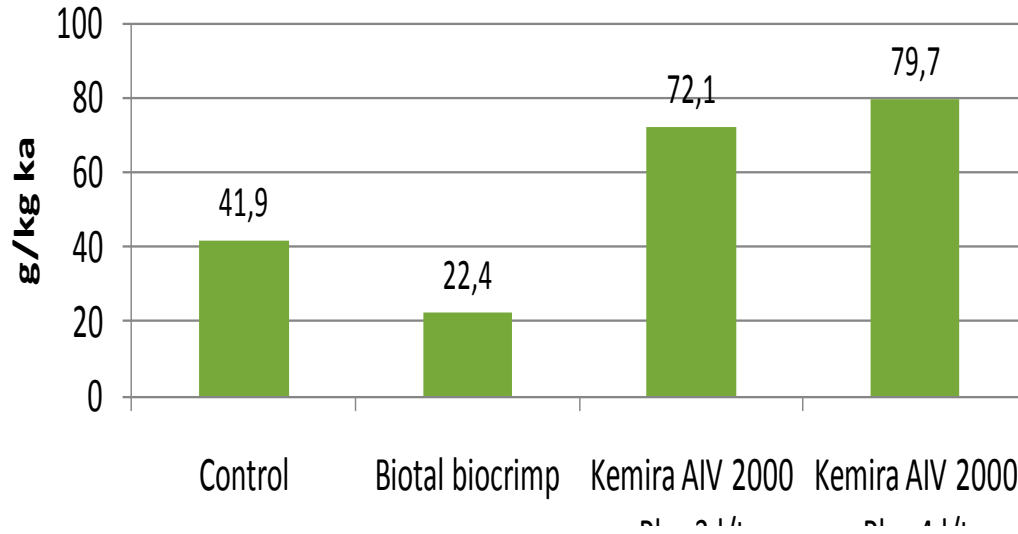


formic acid 425, ammonium formate 303,
propionic acid 100, benzoic acid 22 and
water 150 g/kg

Crimped high moisture barley

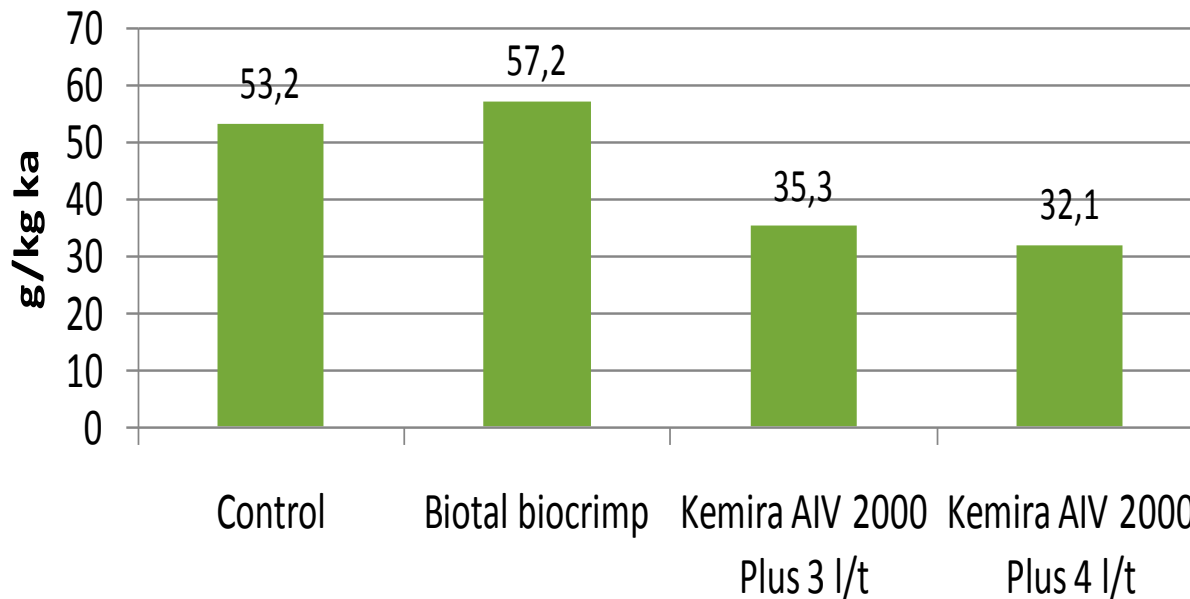


Sugar

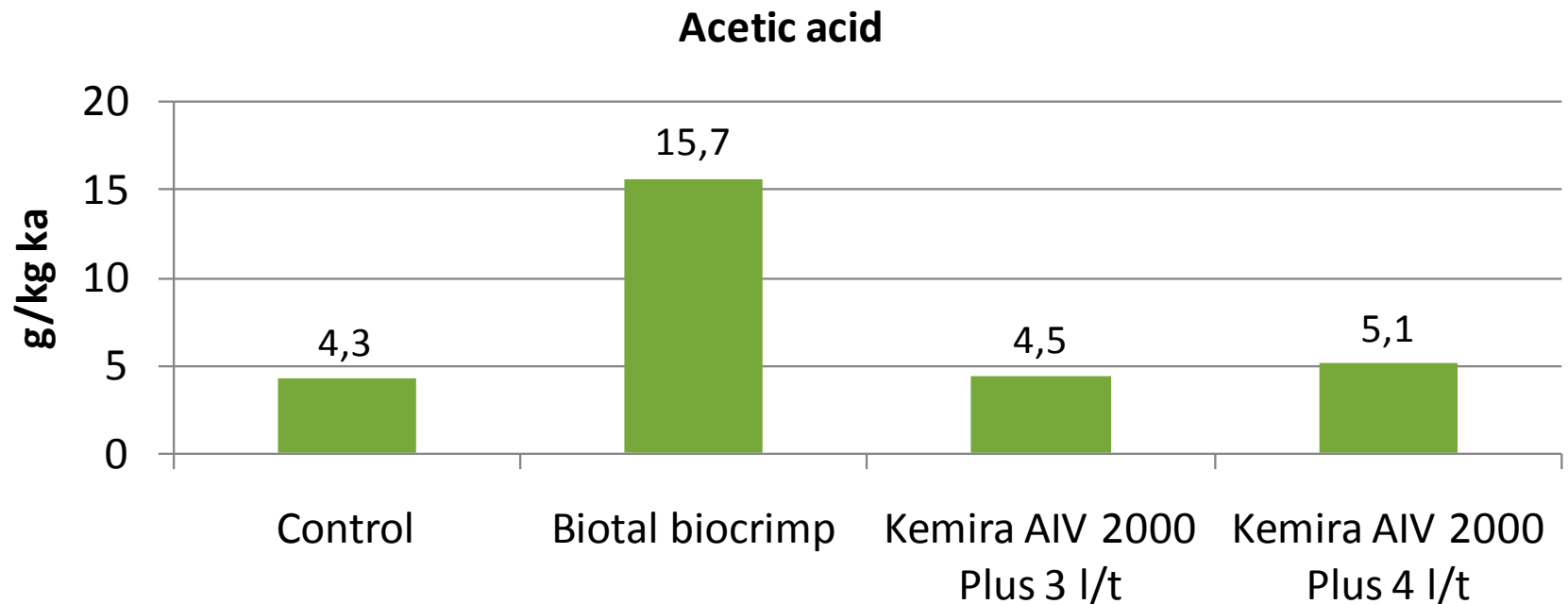


Differences in the quality parameters:

Fermentation products g/kg



Buchneri is heterofermentative – acetic acid may however reduce palatability



All the additives were able to bring better aerobic stability to the grain

Treatment	Aerobic stability, hours
Control	162
Biotal Biocrimp	>300
Kemira AIV 2000 Plus 3 l/t	>300
Kemira AIV 2000 Plus 4 l/t	273

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.







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

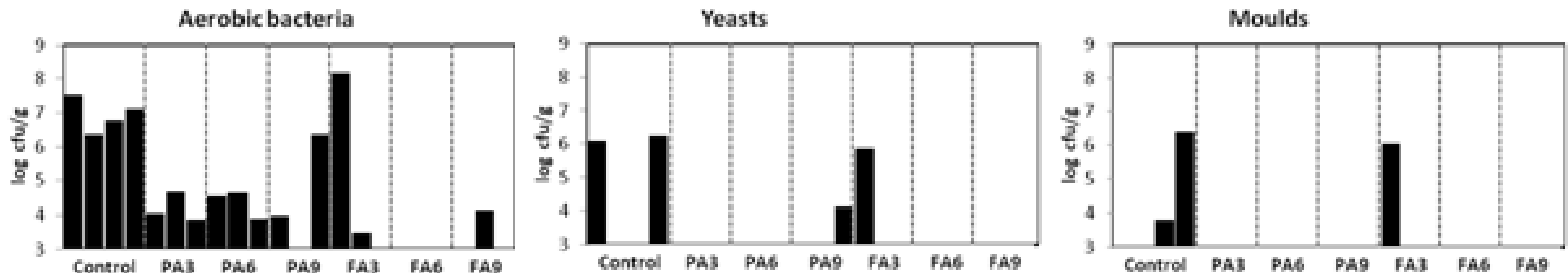
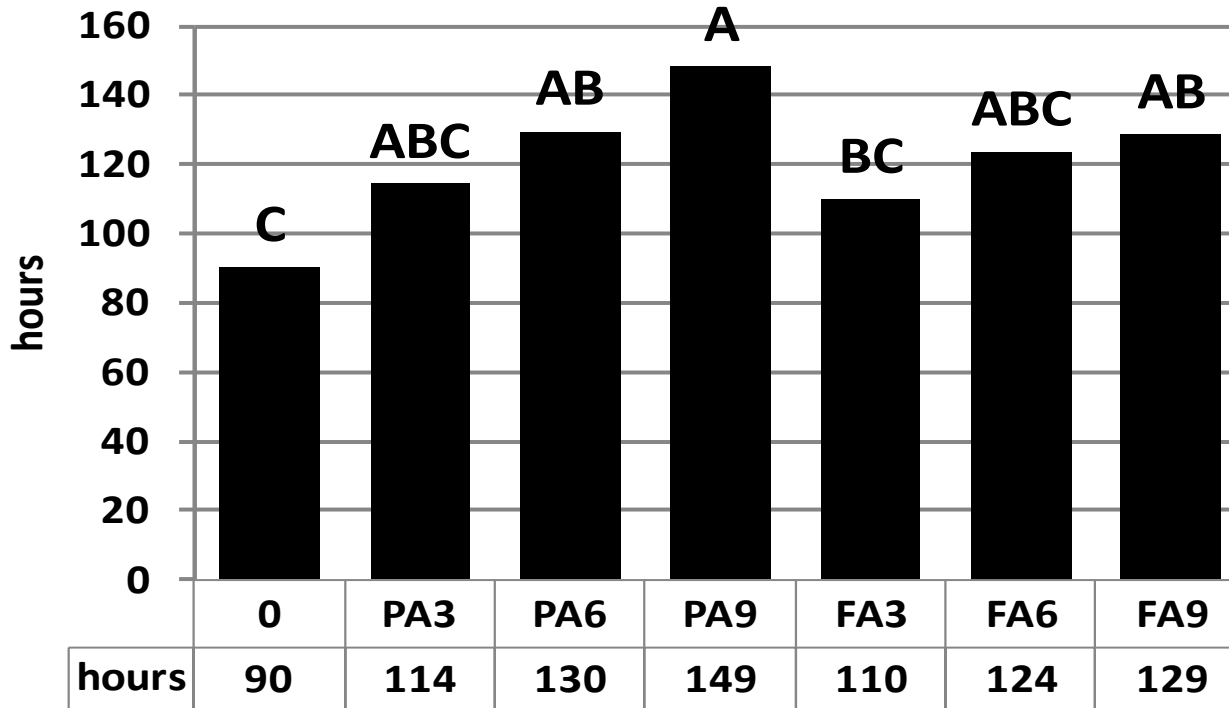


Figure 1. Microbial counts of the crimped barley after ensiling. Each bar within a column represents one replicate.

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



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.
- The additive in grain reduces the load of aerobic microbes coming to the TMR

