

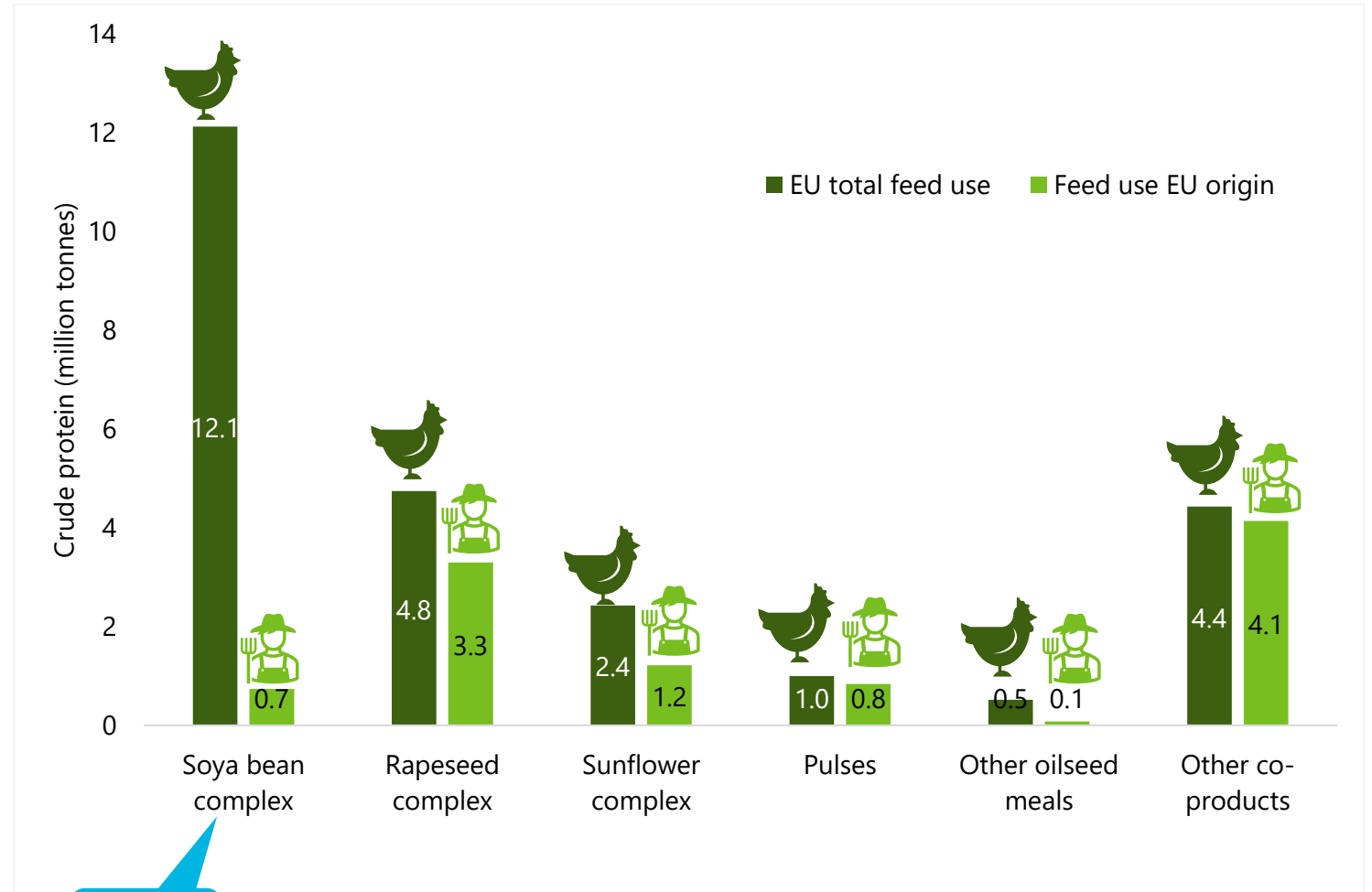
Crimping and ensiling pea and faba bean seeds using different silage additives

Nisola Ayanfe, Tomasz Stefański,
Marcia Franco & Marketta Rinne

Natural Resources Institute Finland
(Luke), Jokioinen, Finland



There is a strong political will to increase the protein self sufficiency in the European Union



Complex includes meals and seeds

EU Feed Protein balance 2022/2023

Pea and faba bean are the most robust grain legumes / pulses in marginal environments such as Northern Europe, where soya bean does not thrive. They are suitable feeds for ruminants & monogastrics.

© Luke

Field pea (*Pisum sativum*)



Faba bean, field bean, horse bean (*Vicia faba*)



Crimping and ensiling moist grains is a good alternative in humid conditions to drying of grains

- Freshly harvested grains / seeds, with moisture content above 14 %, need to be artificially dried, or preserved with other methods
- Ensiling crimped grains is a widely used technology for cost-effective grain preservation under humid conditions
- Moist seeds are processed through a special crimping machine (roller mill) and the resulting feed is ensiled in an airtight storage (silo, tube)
- This method prevents growth of harmful microbes and ensures high quality of feed, even during extended storage times
- It is a flexible and cost-efficient way to store all feed-grade crops with a broad moisture content (15 **20 – 35** 45 %)





Crimping and ensiling seeds provides several benefits to drying under humid harvesting conditions

1 Less weather dependency and wider harvesting window.

2 Modifications during fermentation may increase digestibility and degrade antinutritional factors.

3 Later maturing and higher yielding varieties can be used.



Additives support preservation quality of crimped ensiled seeds

- The objective of the current experiment was to evaluate the potential of different types of additives in preserving crimped and ensiled peas and faba beans
 - Lactic acid bacteria inoculants boost and direct fermentation
 - Formic acid restricts fermentation and growth of harmful bacteria
 - Propionic acid protects against aerobic deterioration
 - Sorbate is an antimicrobial agent



Chemical composition of seeds prior to preservation

Item	Pea	Faba bean
Date of harvest in 2023	13 Sep	23 Sep
Dry matter (DM), g/kg	753	633
Moisture, g/kg	247	367
In DM, g/kg		
Ash	41	56
Crude protein	241	287
Crude fat	16	16
Crude fiber	60	96
Starch	471	385
Water sol. carbohydrates	85	44
Neutral detergent fibre	98	133



Pea



**Faba
bean**

The seeds were crimped using a roller mill at the premises of a local dairy farmer



The experimental design was 2 × 3 factorial



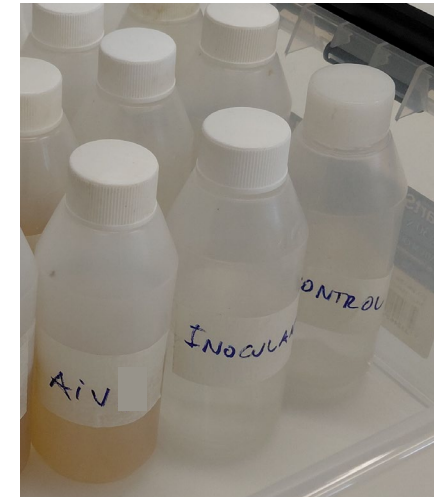
Two different grain legumes

- ✓ Faba bean (*Vicia faba*) cv. Daisy
- ✓ Field pea (*Pisum sativum*) cv. Eso



Three additive treatments

- ✓ Control (without additive)
- ✓ Hetero- & homofermentative lactic acid bacteria (LAB; Kofasil DUO, 1 g/t)
- ✓ An organic acid blend containing formic and propionic acids + potassium sorbate (FPS; AIV Ässä Na, 5 l/t)



The additive-treated crimped seeds were packed in plastic bags (3 kg fresh matter; 4 replicates per treatment) and vacuummed



**The higher moisture
faba bean samples
(darker material)
produced so much
gas that the vacuum
bags inflated**



Pea

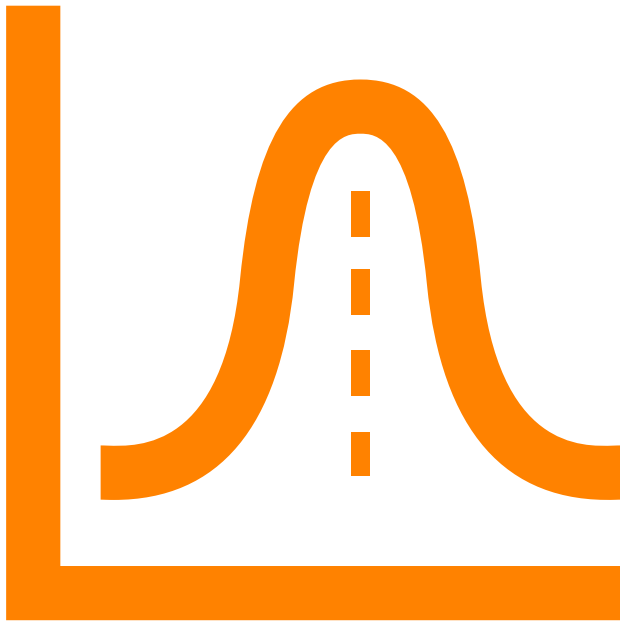


The vacuum bags were opened after an ensiling period of 3 months and samples were evaluated for preservation quality



**Faba
bean**

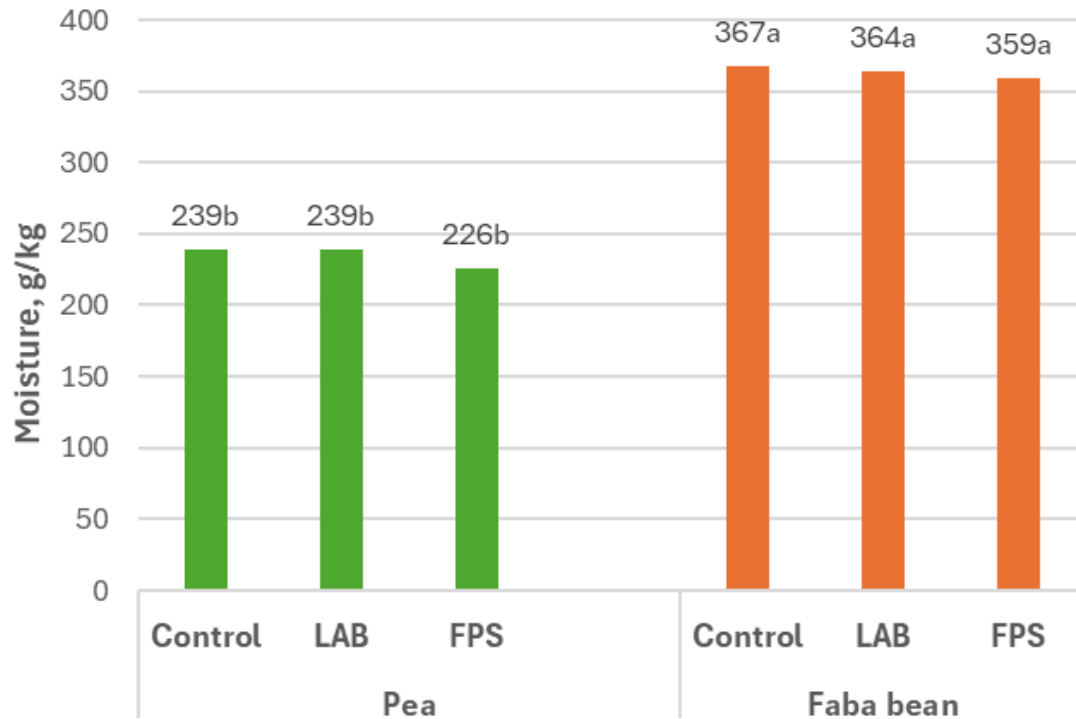
Statistical analysis



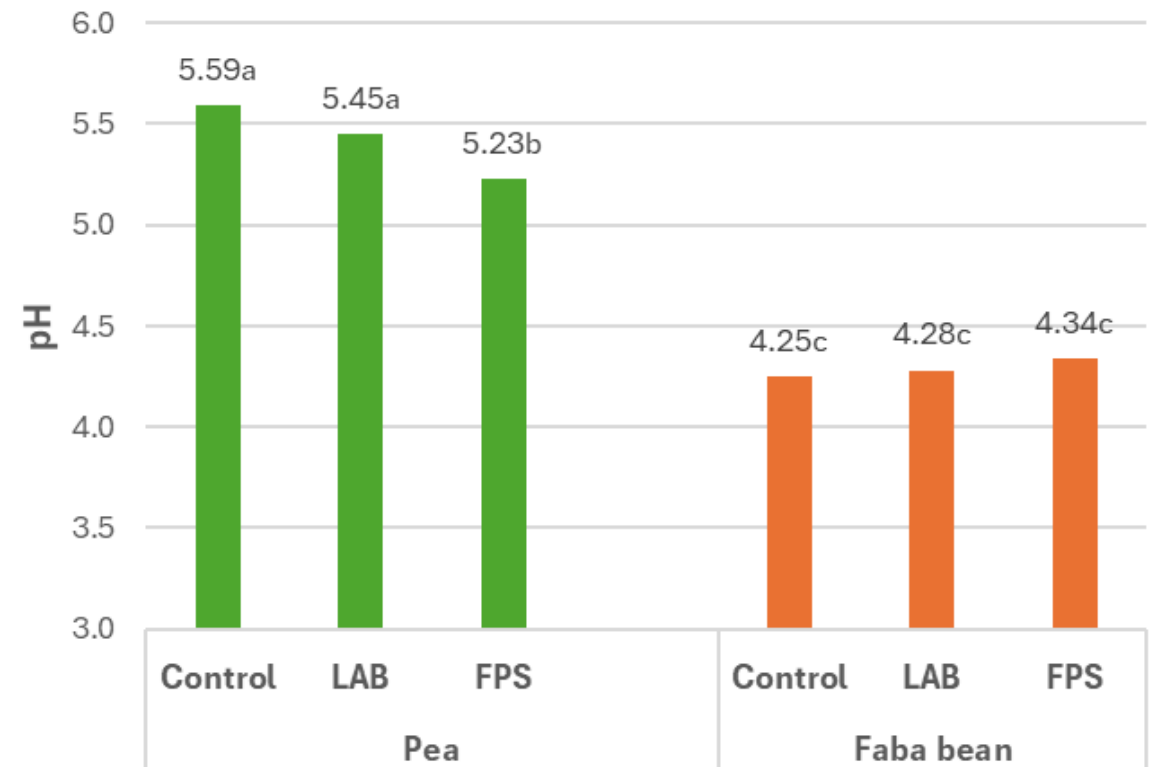
- **Mixed procedure of SAS 9.4**
- **Fixed effect**
 - Species
 - Additive
 - Interaction
- **Random effect**
 - Replicates
- **Tukey test for pairwise comparison**

Moisture content defines the extent of fermentation – and is confounded with species in this case

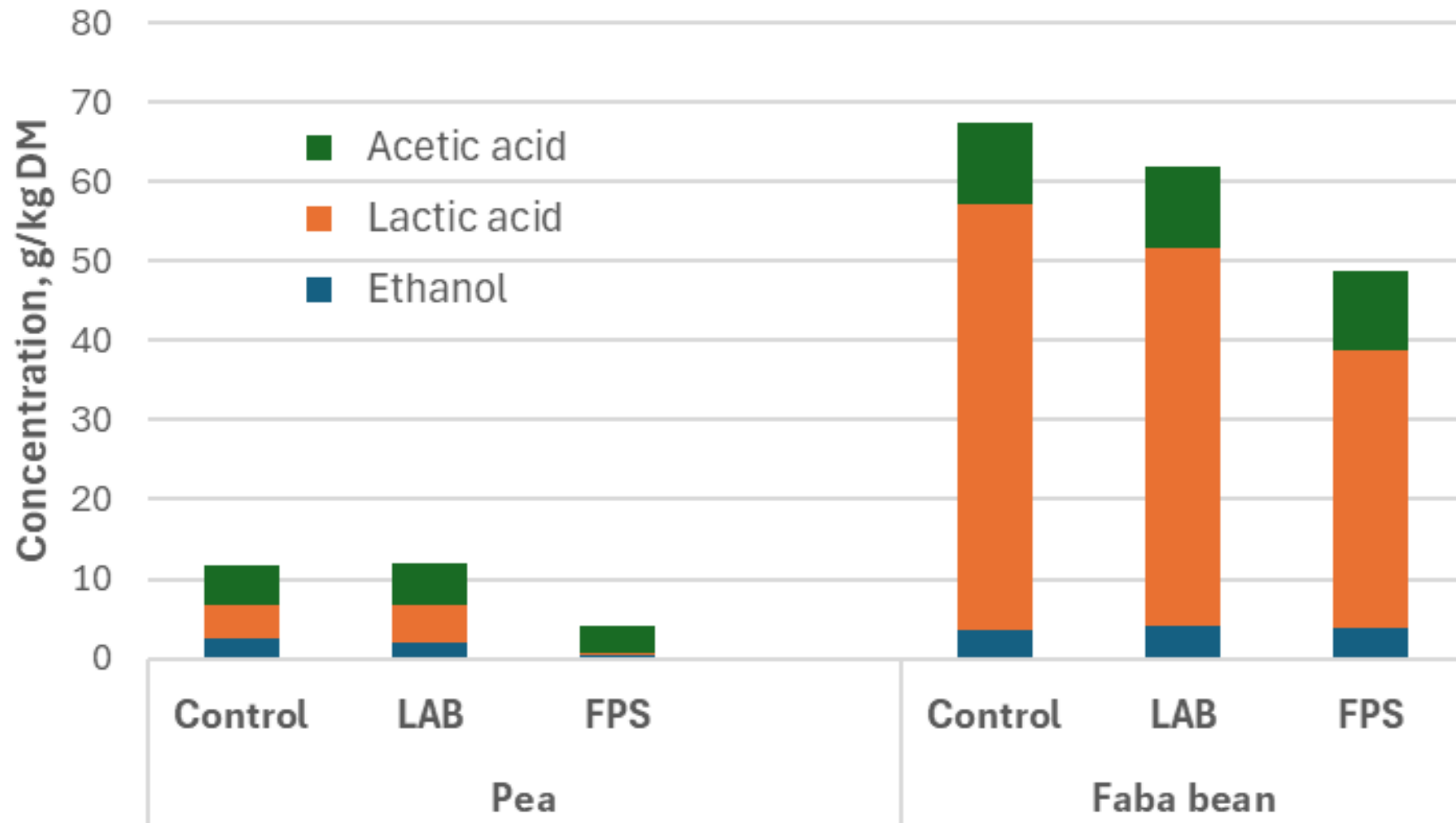
Moisture (mean 235 and 363 g/kg)



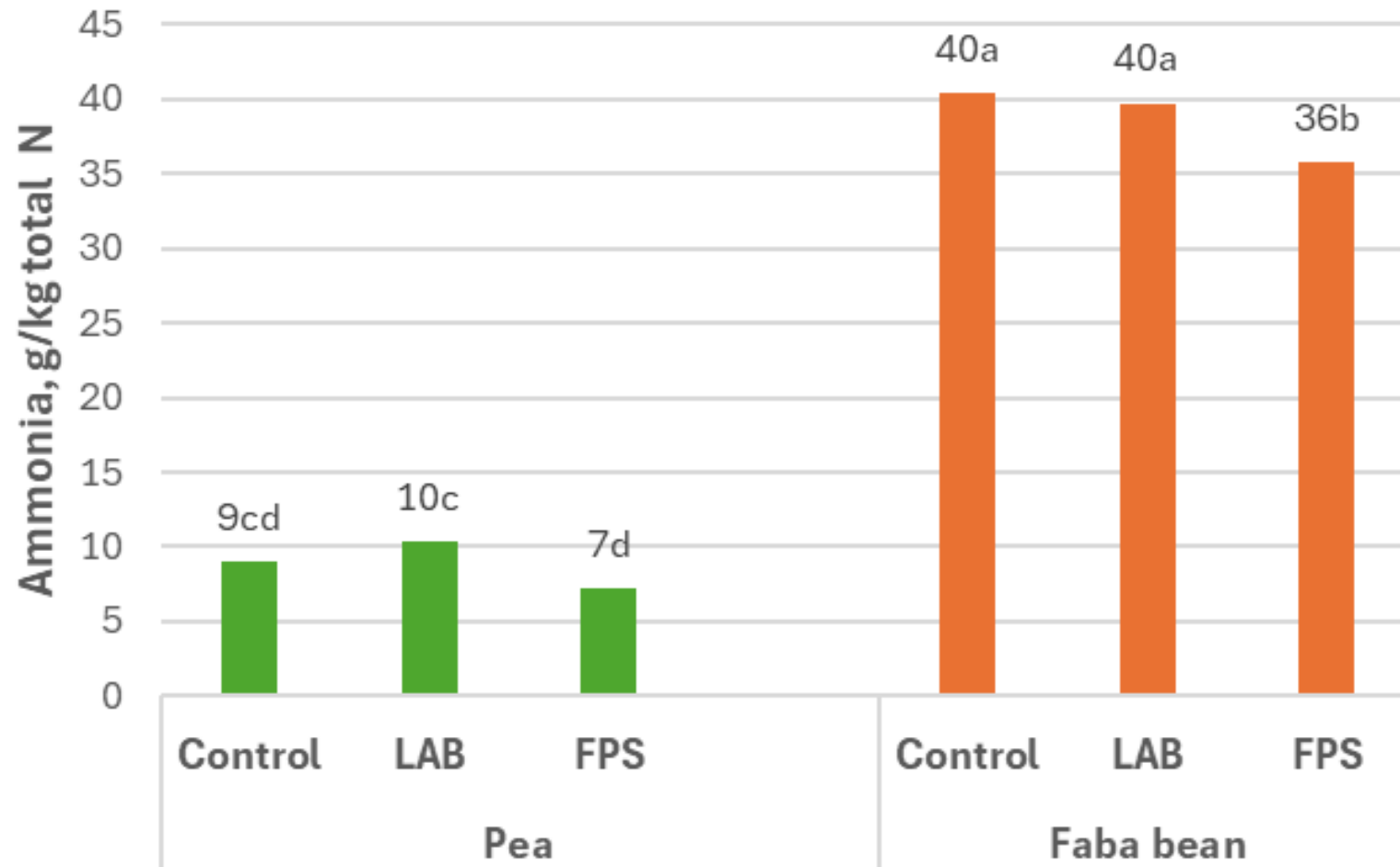
pH (mean 5.42 and 4.29)



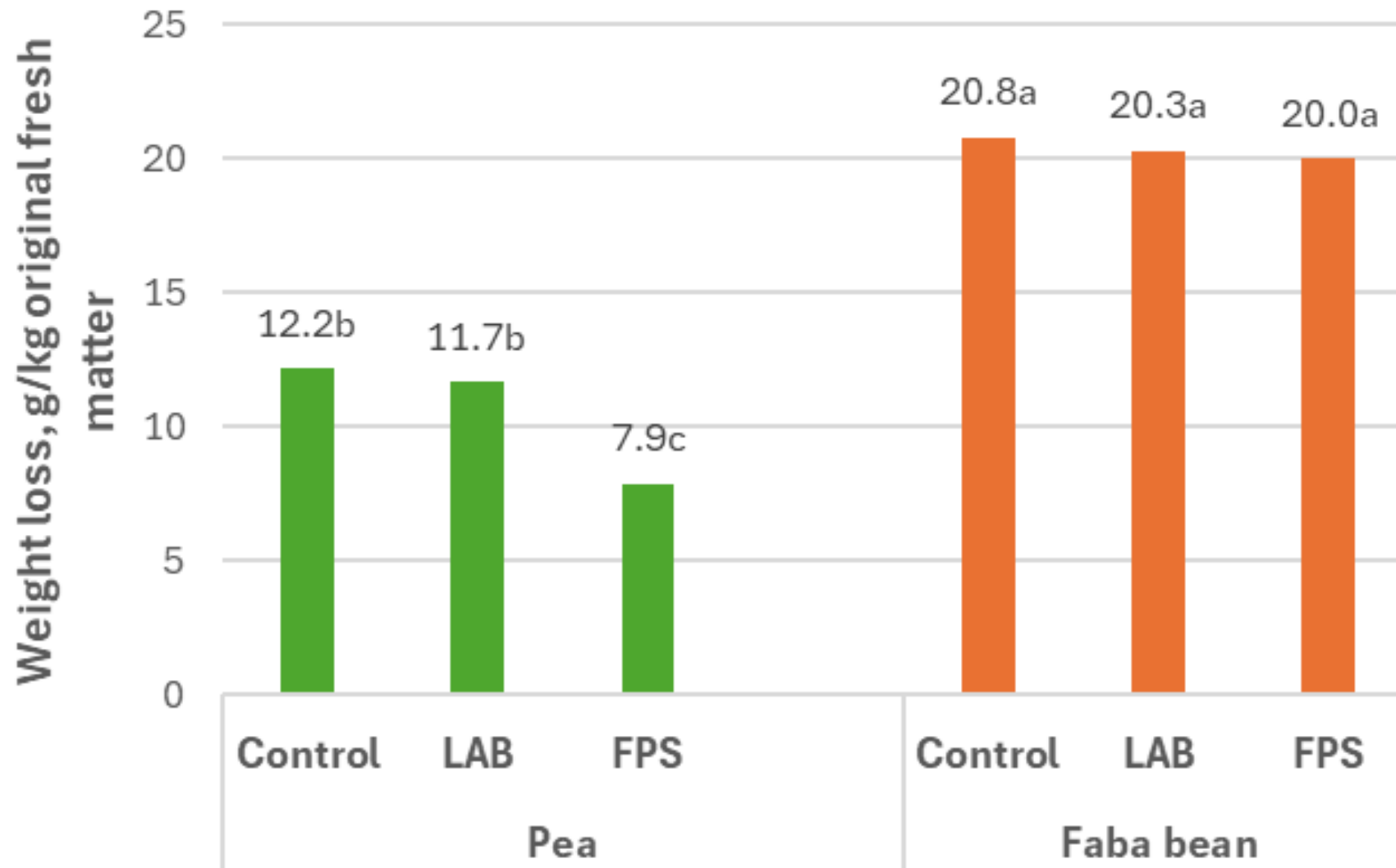
Lower moisture and use of acid blend additive (FPS) reduced the concentrations of fermentation end products



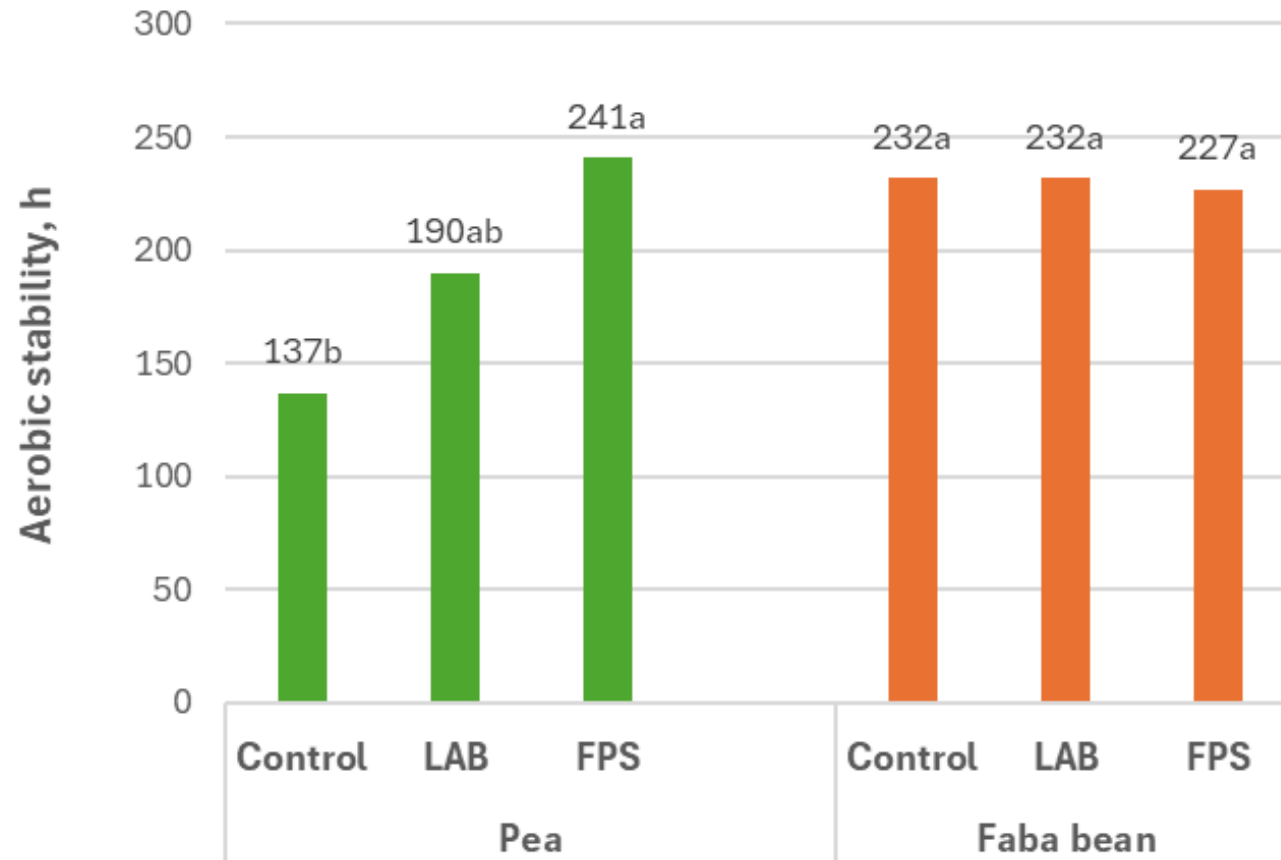
Use of acid blend additive (FPS) reduced the degradation of protein in both drier (pea) and wetter (faba bean) seeds



Weight loss during the preservation period reflected the extent of fermentation



Lower moisture peas were less stable at aerobic exposure than higher moisture faba beans. Use of acid blend additive (FPS) improved the aerobic stability of peas.



What do animals think about ensiled seeds?



There are good scientific and practical experiences from ruminants (dairy and beef) about using ensiled seeds

They fit well in TMR feeding (no grinding needed, no dust)

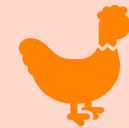
Similar or improved nutritive value as dry seeds

- Huuskonen, A., Rinne, M. & Manni, K. 2020. Effects of different barley grain preservation techniques on intake, growth and carcass traits of finishing dairy bulls fed grass silage-based rations.. The Journal of Agricultural Science 158: 748-755. <https://doi.org/10.1017/S0021859621000022>.
- Rinne, M., Franco, M., Tapio, I., Stefański, T., Bayat A. & Mäntysaari, P. 2022. Effects of grass silage additive type and barley grain preservation method on rumen fermentation, microbial community and milk production of dairy cows. Agriculture 12, 266. doi.org/10.3390/agriculture12020266.

Preliminary data:

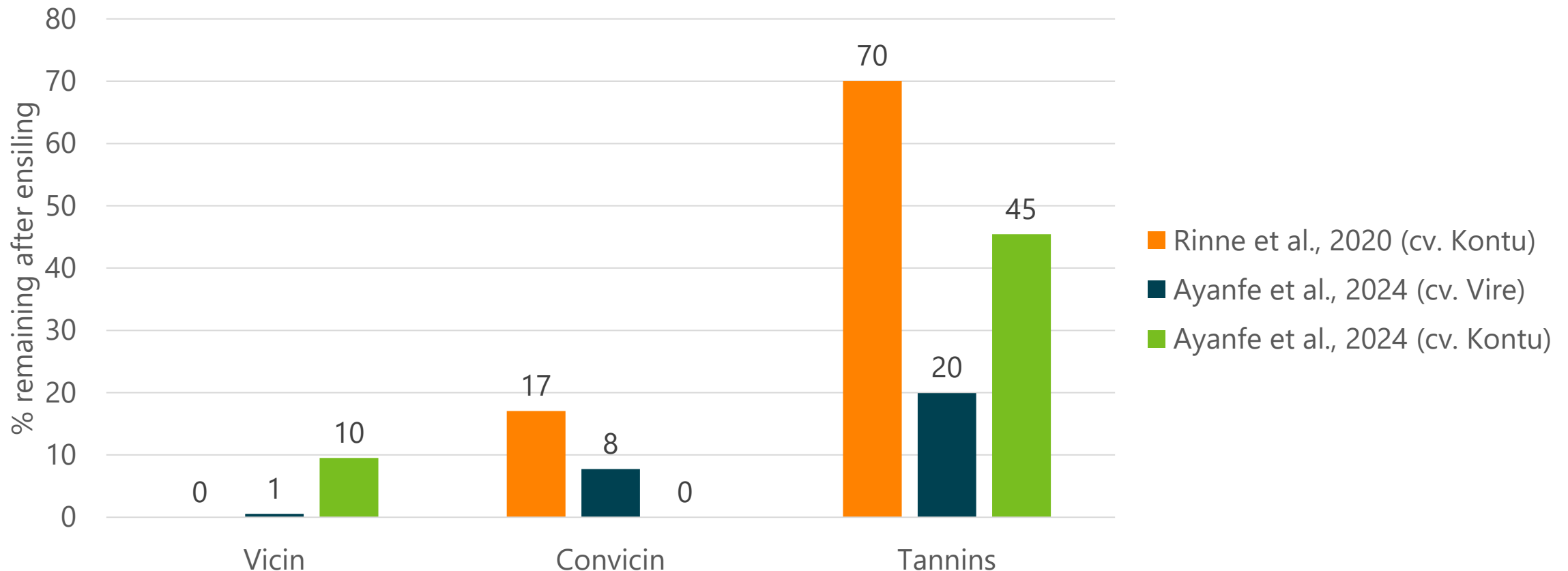


Pigs – improved amino acid digestibility



Poultry – improved amino acid and phosphorus digestibility

Crimping and ensiling has reduced vicin + convicin concentrations and tannins in faba beans – could be an additional benefit



Conclusions

- Crimping and ensiling moist pea and faba bean seeds offers a practical alternative to drying the seeds under humid conditions
- The differences between the plant species were mainly driven by the difference in their moisture content due to environmental conditions
- Using the acid blend additive restricted fermentation and improved aerobic stability, but the lactic acid bacteria inoculant did not affect the preservation quality compared to the untreated Control under the conditions of the present experiment
- Preliminary studies with pigs and poultry indicate positive effects on nutrient digestibility and animal performance, when using crimped ensiled pulse seeds
 - More feeding experiments needed with monogastric farm animals
 - Practical solutions to feeding moist feeds to pigs and poultry in intensive production systems should be developed



Thank you!



luke.fi

