# Intensively manipulated silage to growing/finishing pigs – influence on nutrient utilisation and behaviour

Magdalena Presto Åkerfeldt, SLU, Dept. of Animal Nutrition and Management

# Ley crops in diets to pigs?

- Positive environmental impacts of more perennial green biomass.
- Grass and leguminous plants in crop rotations are positive for soil fertility and increased biodiversity.
- Increased biomass production – DM and crude protein yield.
- Reduced Nitrate leaching compared to cereals and corn.

(Manevski et al., 2017, 2018, Ambye-Jensen, 2019)

- Need for locally produced protein feed ingredients to livestock.
- Organic production - Limited access to high quality organic protein ingredients and legumes important for N-fixation in crop rotation.

→On going projects on green bio-refinery and extraction of green protein concentrate.

(OrganoFinery, SupergrassPork, ProRefine, GreenVALLeys

# Ley crops in diets to pigs?

- Fibers are beneficial for gut health, but can lower nutrient digestibility.
- Additional roughage increase pigs' possibilities to perform foraging/eating/rooting behaviours.

(Høøk Presto et al., 2009; Presto et al., 2013)

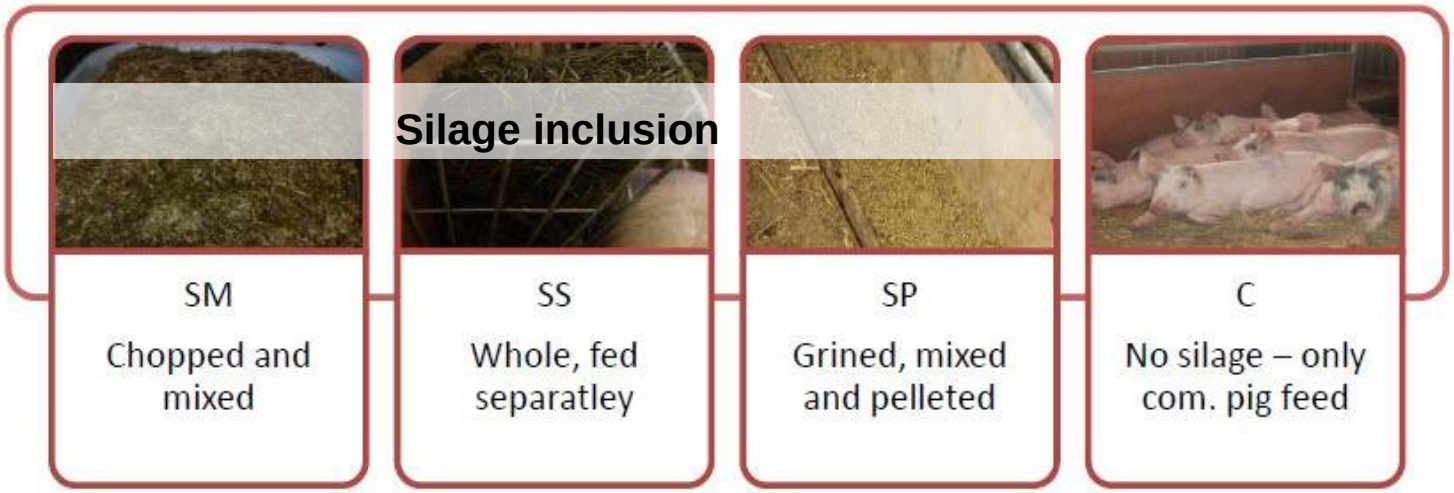
- Ley crops have a positive impact on animal welfare.


# Silage in diets to pigs?

- Ley crops are traditionally preserved as silage with efficient harvesting and storage technologies in place.
- Stable raw material (nutrient quality) & provides a year-around availability.
- Preferred option for organic farmers when roughage is required on a daily basis, however requires heavy work and hard to include in feeding system.


# Inclusion of silage fed as TMR, seperately or pelleted in diets to growing/finishing pigs

- 20% of energy replaced by silage.
- SP pigs performed (growth & carcass traits) comparable with control pigs.
- SM and SS pigs sorted out silage, less energy consumed and poorer growth.
- Larger proportion of activity in SM and SS, less wounds in SS pigs.

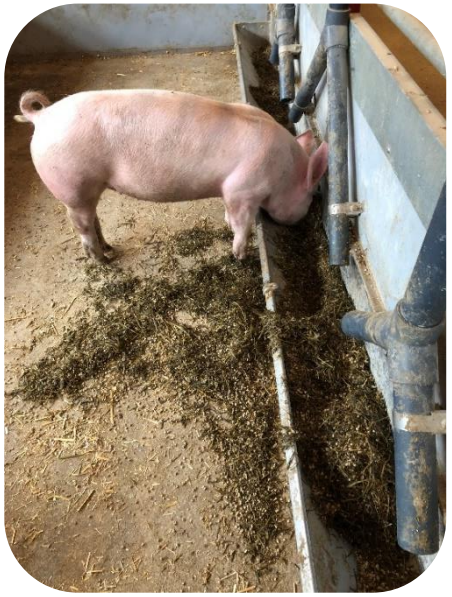



Wallenbeck et al., 2013; Presto et al., 2014

# Major challenges

The major challenge of feeding pigs with silage is, in addition to maintaining high nutritional quality.

also finding feeding techniques that reduce the amount of sorted out feed, without losing its function as enrichment.



# Aim and hypothesis

Aims:

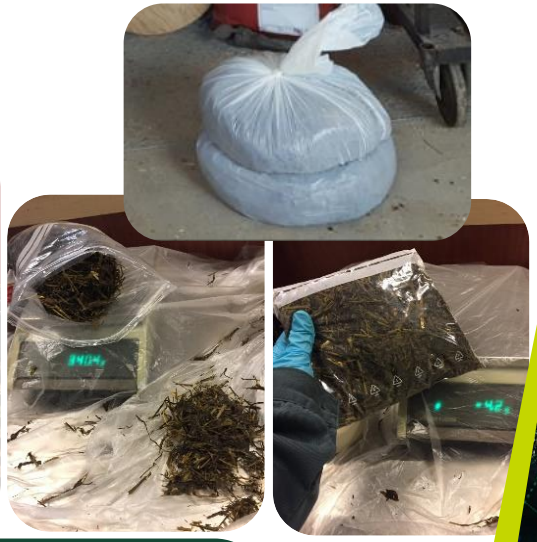
- Achieve knowledge on practical and ethical implications of silage inclusion in total mixed rations (TMR) to pigs.
- How silage with an even shorter length (than those about 1-3 cm for chopped silage) in TMR influence pigs' nutrient utilisation and feeding behaviour.

Hypotheses:

- Reduce pigs' ability to sort out different parts of the feed.
- Increase the consumption and nutrient utilization of the silage.
- The structure of the silage can function as behavioural enrichment.

# What did we do?
## Silage

Chopped (1-3 cm) grass/red clover silage



½ intact (chopped)

½ manipulated in a bio-extruder (for finer structure)

-Weighed into portions

-Stored in freezer prior to feeding

# What did we do?
## Bio-extrusion and TMR





(Lehmann Maschenbau)

# What did we do?
## Dietary treatments

### SI

Total mixed ration (TMR)

Ceral based feed mixed with chopped and intensively manipulated silage

20% inclusion (DM basis)

DM: 33.2%  NE: 7.3 MJ

### SC

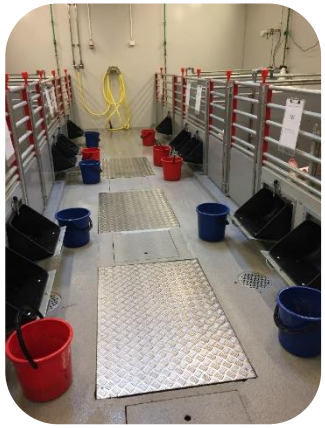
Total mixed ration (TMR)

Ceral based feed mixed with chopped (1-3 cm) silage

20% inclusion (DM basis)

DM: 32.5%  NE: 7.2 MJ

# What did we do?
## Digestibility trial



- 10 pigs (Y*H) individual pens fed either SI or SC (n=5).
- 7 d experimental period with 4 d faecal + feed residual collection.
- $TiO_2$ as indigestible marker in all diets and a control diet with only ceral based feed (post-experimental period) for digestibility calculations.
- Feed consumption and total tract apparent digestibility (TTAD) of nutrients was calculated.

TTAD calculated with indicator technique (Sauer et al., 2000) according the equation:

$TTAD_T = 100 - (I_T * DC_F) / (DC_T * I_F)$

TTAD for nutrients in silage calculated according to the equation:

$TTAD_{Sil} = AD_F + [(AD_F - AD_{Bas}) * (propDC_{Bas}) / (propDC_{Sil})]$

# What did we do?
## Behaviour trial



- 64 pigs (Y*H) fed either SI or SC (2 batches, 2 SI + 2 SC pens/batch, 8 pigs/pen).
- 6 d experimental period with 2 d behaviour observations.
- Direct observations 3 times/day
  - prior to and after feeding in morning and afternoon
  - separate from feeding in the middle of the day
- Instantaneous (scan) and continuous sampling.

Activity behaviours e.g. laying, siting, standing, eating, rooting, manipulating surrounding.

Social interactions e.g. contact with other pig, biting, pushing, climbing or fighting with other pigs.

# What did we find?

- SI pigs consumed more silage than SC pigs.
  - 95% vs. 77% of the silage ration (digestibility trial).
  - Visual estimation showed that SI finished all silage while SC had left-overs (behaviour trial).

- No difference in TTAD of OM, CP, NDF and energy for the diets.
- No statistical difference in TTAD of OM, CP, NDF and energy for the silage.

| | Diet | | | | | Silage | | | |
|---|---|---|---|---|---|---|---|---|---|
| | SI | SC | SEM | P-value | | SI | SC | SEM | P-value |
| **OM** | 72.5 | 73.0 | 2.10 | 0.736 | | 31.3 | 23.6 | 9.74 | 0.373 |
| **Energy** | 71.3 | 71.2 | 1.75 | 0.928 | | 35.6 | 24.0 | 4.99 | 0.146 |
| **CP** | 60.2 | 60.2 | 3.15 | 0.985 | | 16.8 | 8.1 | 12.96 | 0.345 |
| **NDF** | 39.0 | 37.6 | 3.02 | 0.755 | | 32.3 | 31.6 | 7.50 | 0.956 |

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  - Large numerical variation in OM, CP and energy, in favour for SI

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# What did we find?

Before feeding:

| | SI | SC | SEM | P-value |
|---|---|---|---|---|
| **Social interactions** | 8.5 | 13.0 | 0.17 | 0.029 |

After feeding:

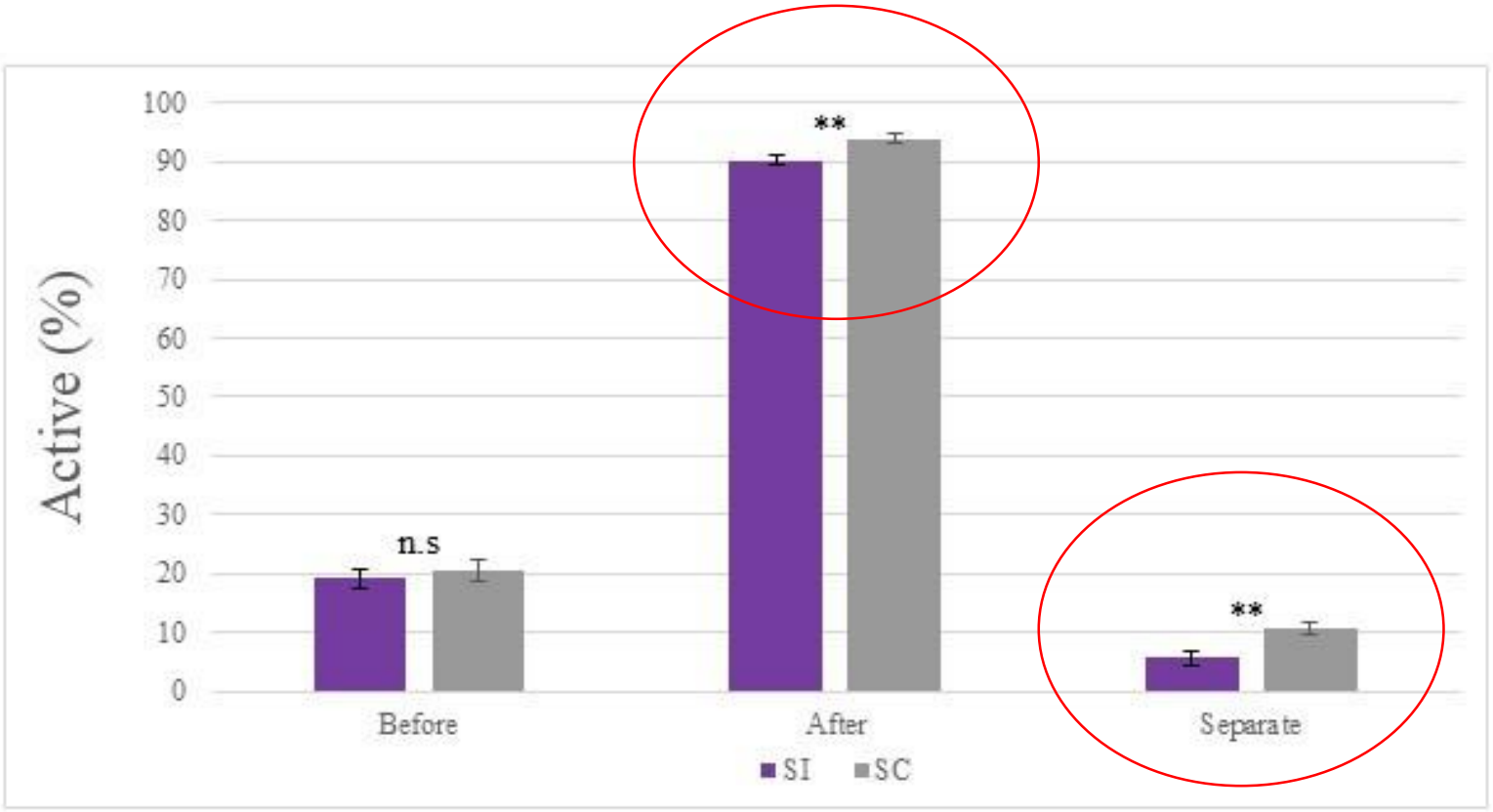
| | SI | SC | SEM | P-value |
|---|---|---|---|---|
| **Eating** | 53.6 | 35.9 | 0.32 | < 0.01 |
| **Rooting** | 15.6 | 37.8 | 0.25 | < 0.01 |

Separate from feeding:

| | SI | SC | SEM | P-value |
|---|---|---|---|---|
| **Rooting** | 1.8 | 5.3 | 0.13 | 0.016 |

P-values, SEM and number of times behaviours occurred per 8 minutes in the different treatments and pig weights before feeding, N=16, after feeding, N=64 and separate from feeding, N=32.

# What did we find?




Percentage of active pigs in the different treatments before feeding, N=64, after feeding, N=256, and separate from feeding, N=128

# What can we conclude?

Providing pigs with TMR with inclusion of intensively manipulated silage:

- Reduce pigs' ability to sort out different parts of the feed
- Increase feed consumption level, thus benefit nutrient utilisation of the silage
- Have the potential to improve nutrient digestibility, however more research is needed
- Function as behavioural enrichment and possibly also influence the satiety of the pigs
- Practical feeding techniques needed

# How do we continue?

New 4-year project started 2019

”Increased utilization of ley crops in feed for organic pigs – feeding strategies and influence of dietary inclusion of grass/clover silage on production, fertility, N-emission and pig behaviour”

Aims to evaluate:

1. Pre-treatment of ley crop silage on pig performance and behaviour.
2. The N use efficiency at pig and farm level and environmental impact of N in faeces and urine and influence on NH losses at high dietary inclusion of ley crop silage to pigs.
3. Relationships between ley crops diets, pigs’ explorative behaviour and the microbiota-gut-brain axis.
4. The metabolism and biological effects of phytoestrogens in sows fed red clover silage.
5. The farm level economic effects of introducing ley in the feed regimen in piglet and slaughter pig production.

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# Questions or thoughts

CONTACT DETAILS:
Magdalena Presto Åkerfeldt
Dept. of Animal Nutrition and Management

magdalena.akerfeldt@slu.se

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