# More methionine in sows and piglets diets for better growth and immune response of weaned piglets


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# Background

- Sows nutrients requirement including amino acids are increased during the last gestating phase especially in primiparous sows. (Schneider et al. 1992, NRC 2012).

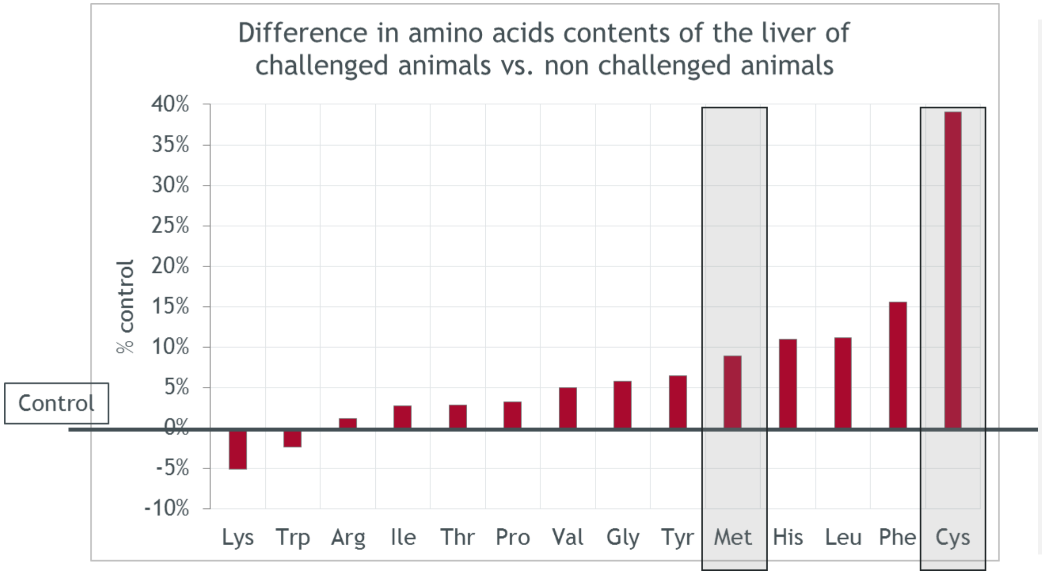
- Previous results investigating increased TSAA supply (NCR +25%) from farrowing to weaning, in lactating sows and during first age weaned piglets showed room to improve sows' milk quality and litter performance until 35 days old (Zhang et al. 2015; Li et al. 2014). However, this strategy didn't affect sows' body composition.

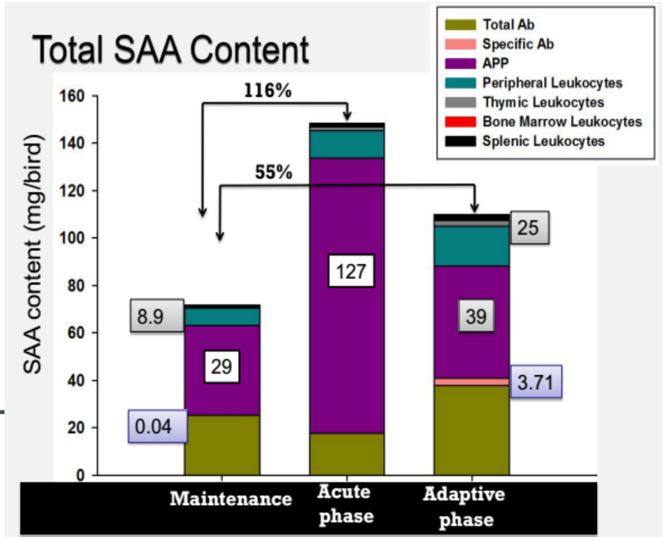
- The metabolism of sulfur amino acids is deeply modified during inflammation and cysteine is a product limiting step in many biochemical approaches leading to an effective response (Santangelo 2002).

- Hydroxy-methionine is known to be better transsulfurated than Methionine leading to higher Cysteine and Taurine synthesis. (Martin Venegas et al. 2006)

# Shift in liver AA demand for acute-phase proteins synthesis

Sulfur amino acids demand is partially explained by the high content of acute-phase proteins in Met+Cys, particularly cysteine

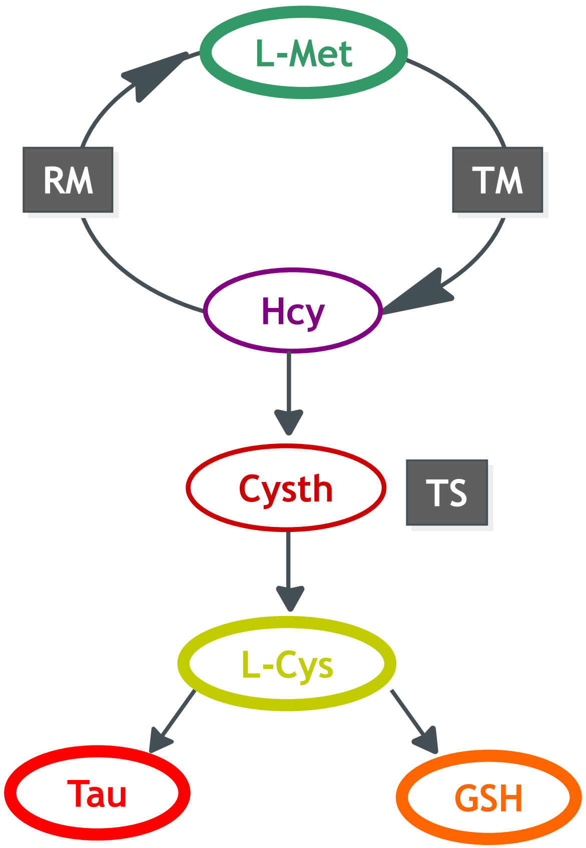


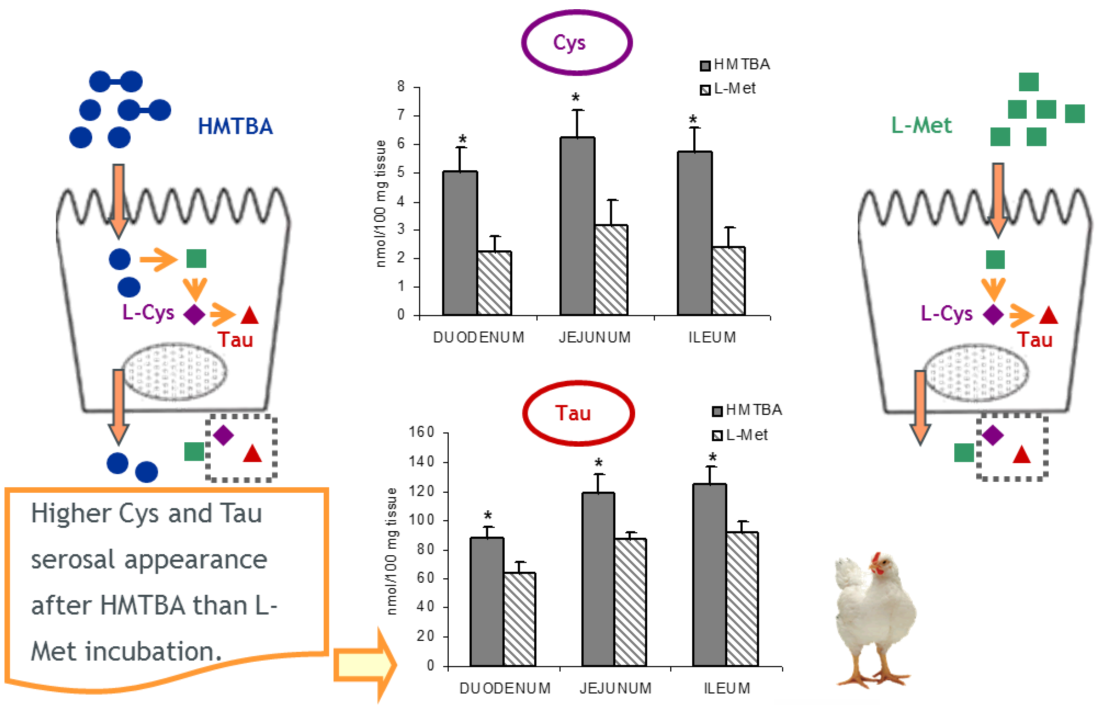

*From Klasing et al., 2013*

# Differential transsulfuration of synthetic methionine sources

Methionine is the precursor of cysteine and antioxidant compounds like Glutathione




HMTBA has been demonstrated to be better transsulfurated than L-Met, thus leading to more cysteine




Martin-Venegas *et al.* 2006

# Scientific questions

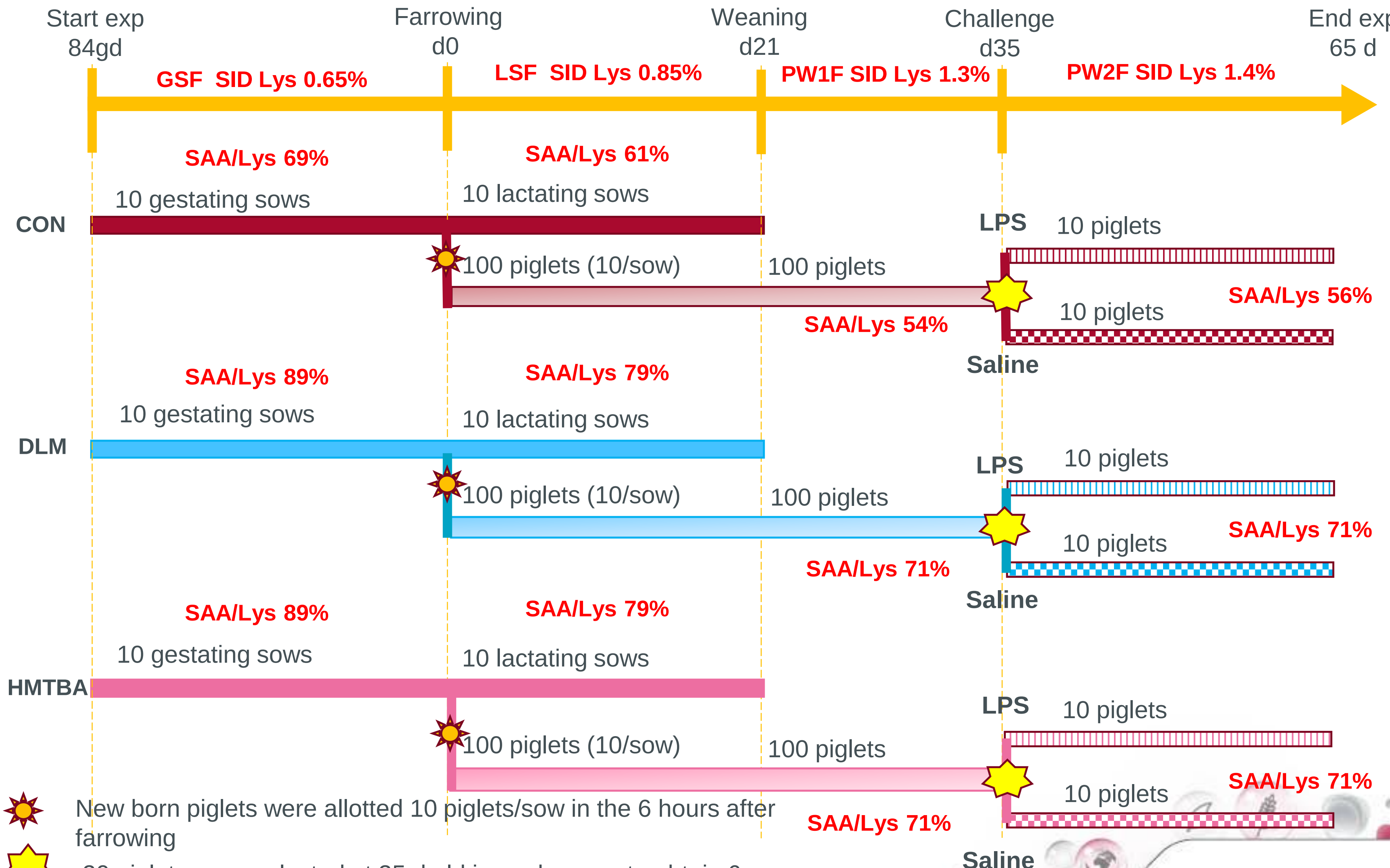
1. *Are the current recommendations in sulfur amino acids adequate to meet the needs of modern gestating and lactating sows to sustain body score, milk synthesis and litter's growth until 21 d ?*
2. *Is post weaning supplementation of higher sulfur amino acid level could help managing inflammation event ?*
3. *Is the effect of increasing TSAA, can be modulated depending on metabolic particularity of the supplementary methionine source under inflammation ?*

# Objectives of the study

1) The objective of the first phase of the trial was to assess the effect of increased TSAA supply (+25 % NRC2012), with DL-Methionine or DL-Hydro-methionine on sows condition score and milk production and suckling piglets growth.
2) The objective of the second phase was to assess if increased TSAA supply (+25 % NRC2012) during post weaning period will improve piglets resistance to inflammatory stress.
3) Validate if differential transsulfuration on methionine sources can affect the piglets response.

# Study design and AA levels and treatments

Prim. Landrace x Yorkshire Sows **X** Duroc x Large White x Landrace males




New born piglets were allotted 10 piglets/sow in the 6 hours after farrowing

20 piglets were selected at 35 d old in each group to obtain 6 groups of 10 piglets of similar weight 8.20 ± 0.63 kg

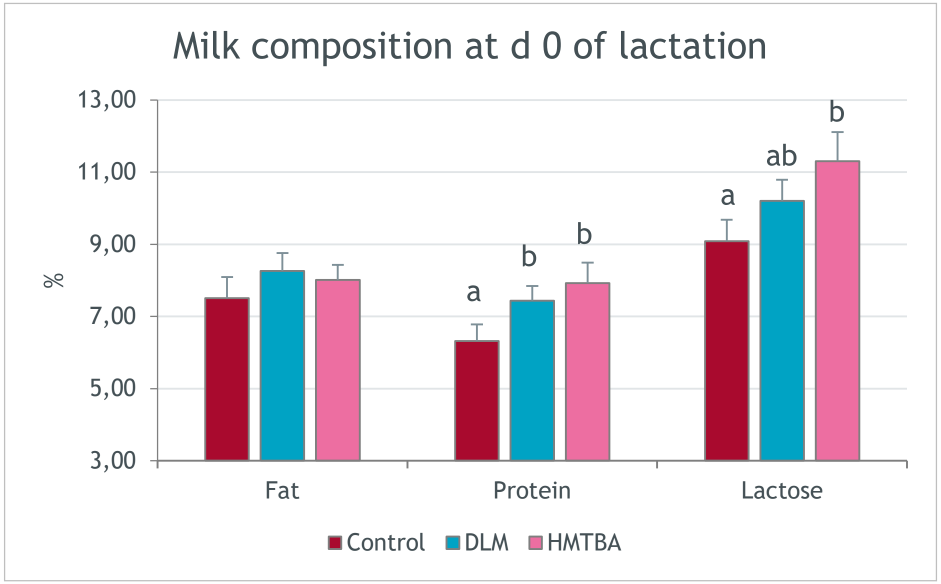
# Treatment effects on sows body condition

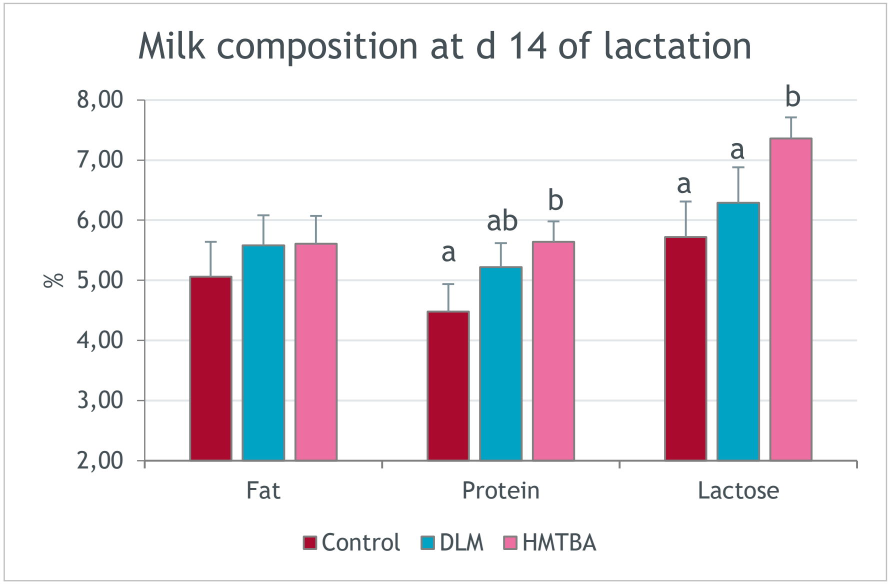
**Increasing dietary TSAA level in late gestating and lactating period allowed decreasing sow weight loss and back fat mobilization during lactating period without changing feed intake.**

| | Control | DLM (+25%TSAA) | HMTBA (+25%TSAA) | *P-value* |
|---|---|---|---|---|
| Body weight, kg | | | | |
| Gestation d 85 | 174.1 ± 3.7 | 172.0 ± 3.2 | 169.5 ± 4.9 | *ns* |
| Lactation d 1 | 179.3 ± 4.0 | 173.9 ± 4.4 | 171.1 ± 3.3 | *ns* |
| Lactation d 21 | 173.0 ± 5.1 | 169.6 ± 3.9 | 170.8 ± 5.2 | *ns* |
| Changes (Lactation d 1-21 ) | -6.29 ± 1.52* | -4.25 ± 2.77 | -0.33 ± 2.81* | *0.10* |
| | *P = 0.08* (Control vs HMTBA) | | | |
| Backfat thickness, mm | | | | |
| Gestation d 85 | 17.4 ± 0.9 | 18.3 ± 1.0 | 17.7 ± 0.8 | *ns* |
| Lactation d 1 | 18.5 ± 1.0 | 19.5 ± 1.0 | 19.0 ± 0.9 | *ns* |
| Lactation d 21 | 16.5 ± 0.9 | 17.9 ± 1.1 | 18.4 ± 0.8 | *ns* |
| Changes (Lactation d 1-21 ) | -2.00 ± 0.53# | -1.61 ± 0.31 | -0.61 ± 0.36# | *0.07* |
| | *P = 0.05* (Control vs HMTBA) | | | |
| Sows feed intake | | | | |
| Gestation d 85 to d114 | 3.12 ± 0.24 | 3.17 ± 0.16 | 2.97 ± 0.13 | *ns* |
| Lactation d 1 to d 21 | 5.26 ± 0.09 | 5.32 ± 0.13 | 5.26 ± 0.12 | *ns* |

**Hydroxy methionine supplementation allowed more marked difference with control group than DL-Methionine**

# Treatment effects on sows' milk composition

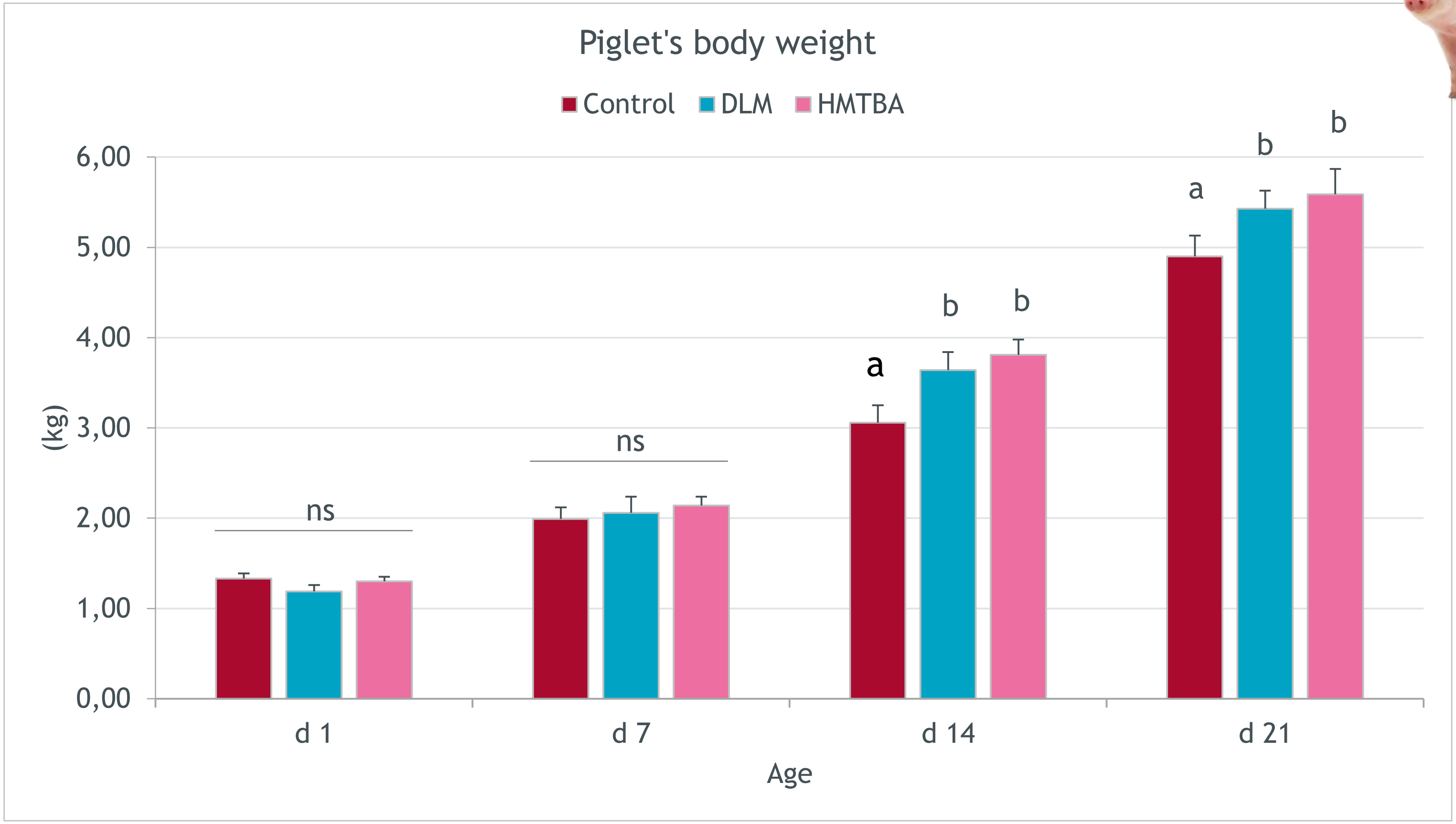



Protein content increased with DLM and HMTBA as a result of the higher amino acids levels observed with those two treatments.

*A previous studies reported increased circulating glucose with higher methionine supply in sows (Zhang et al. 2015) and piglets (Castellano et al. 2015) that could explain higher lactose in milk.*

# Piglets' performance during the **lactating** period




*The milk quality improvement benefits to the offspring growth during lactation*

*These results are agreement with those of Zhang et al. (2015).*

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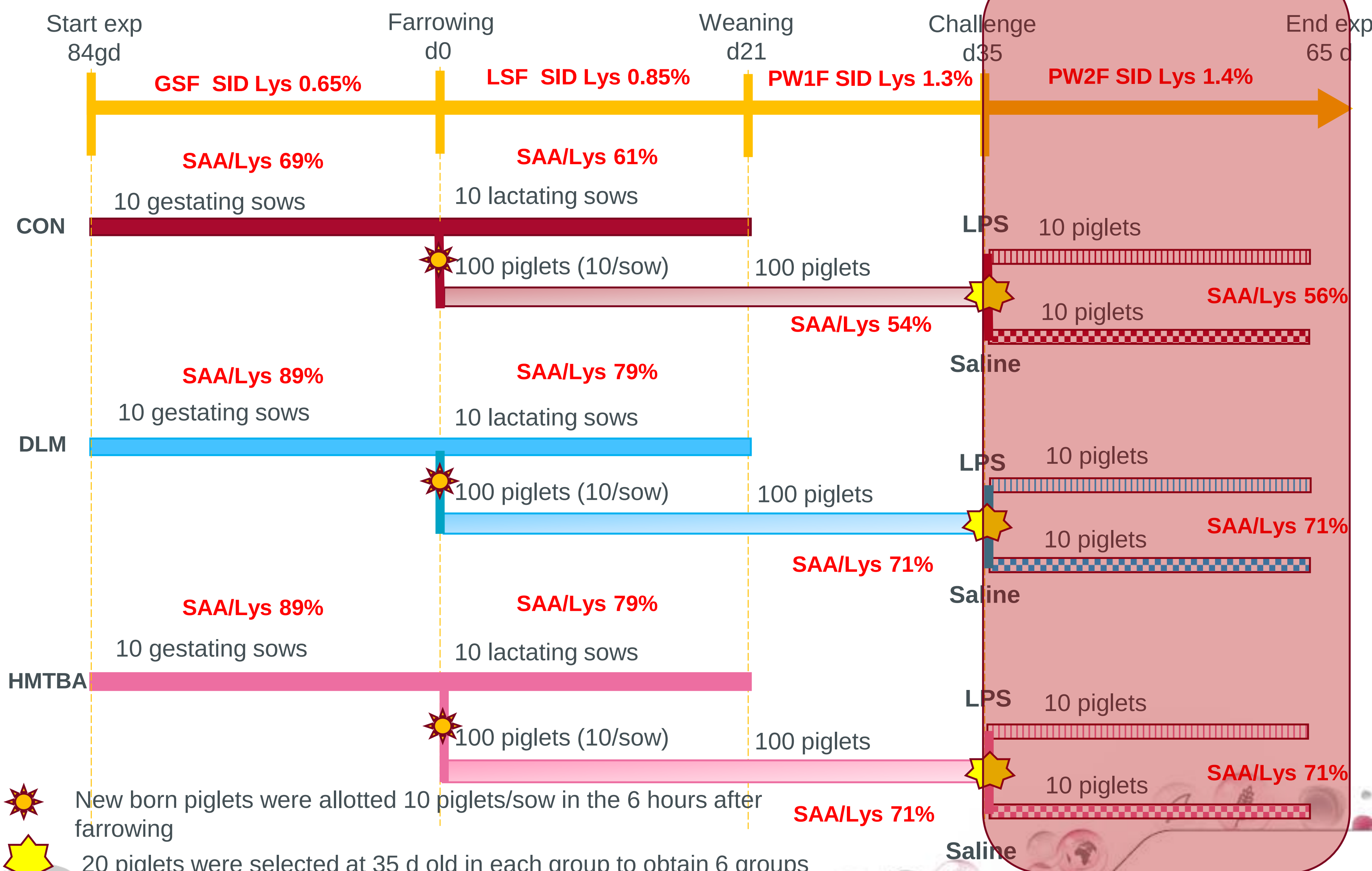
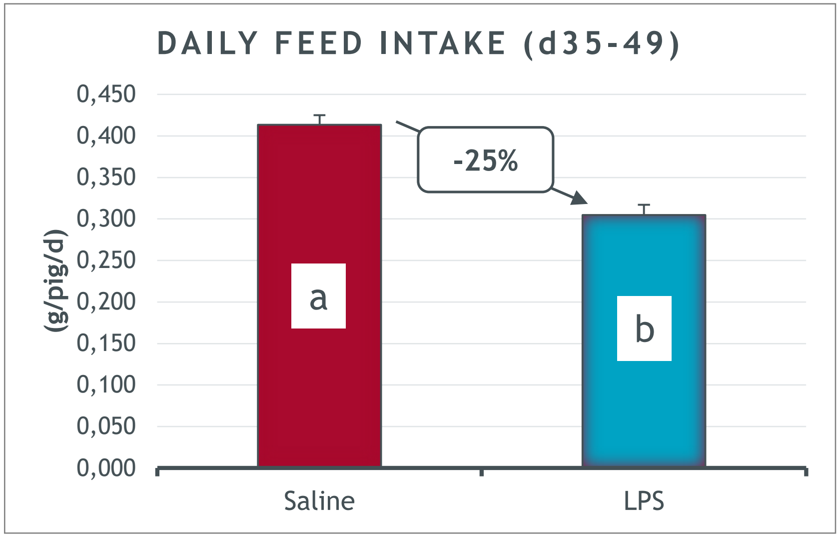
Prim. Landrace x Yorkshire Sows **X** Duroc x Large White x Landrace males

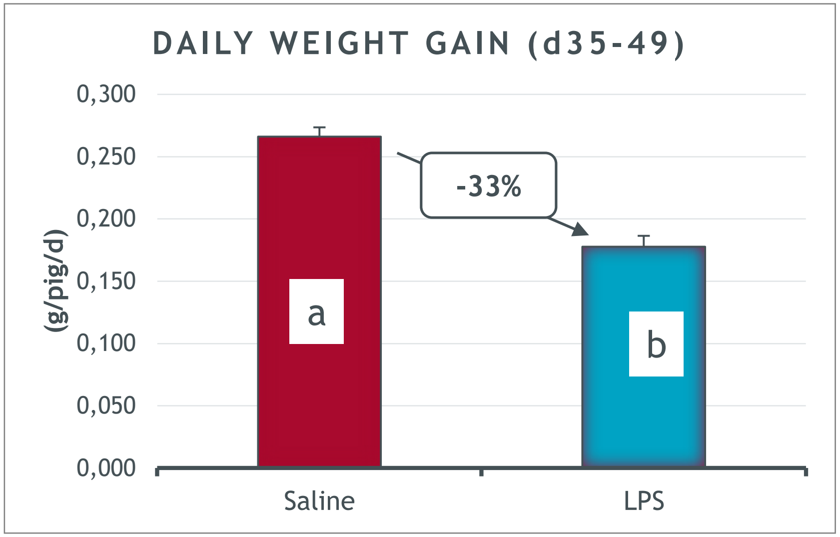


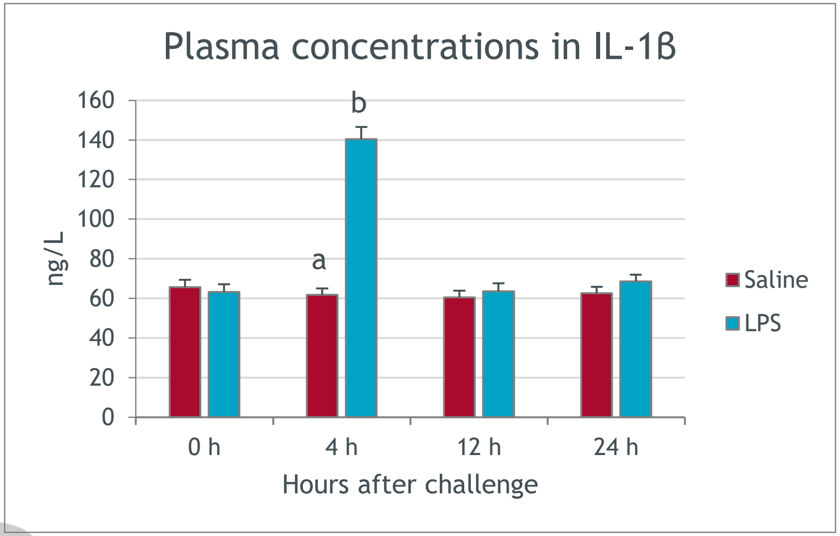

New born piglets were allotted 10 piglets/sow in the 6 hours after farrowing

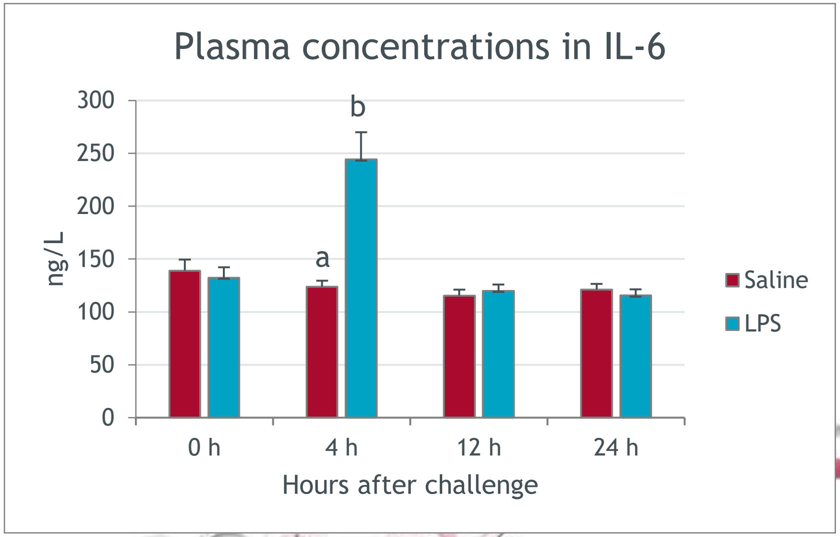
20 piglets were selected at 35 d old in each group to obtain 6 groups of 10 piglets of similar weight 8.20 ± 0.63 kg

# LPS-injection significantly affected feed intake, growth performance and pro-inflammatory cytokines

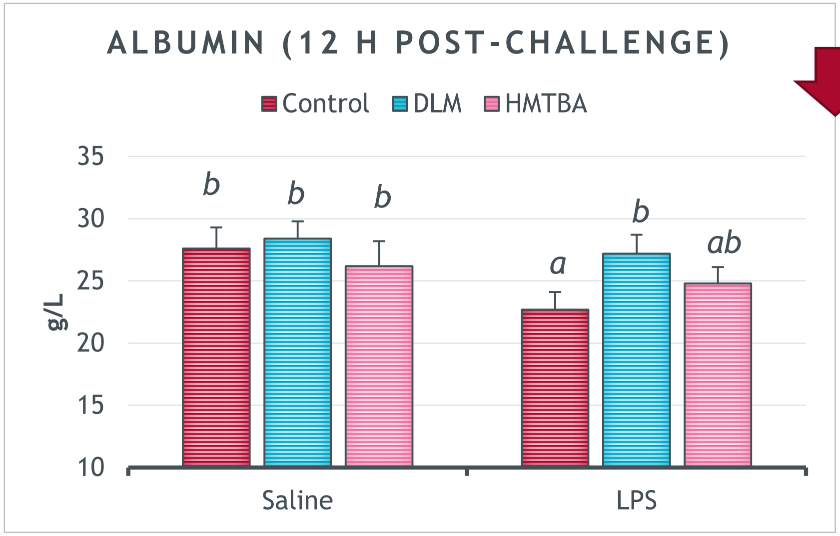


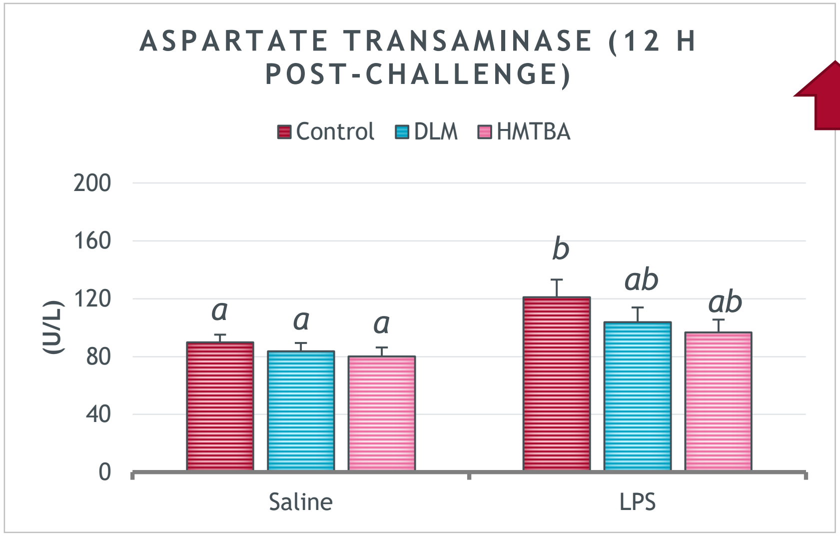



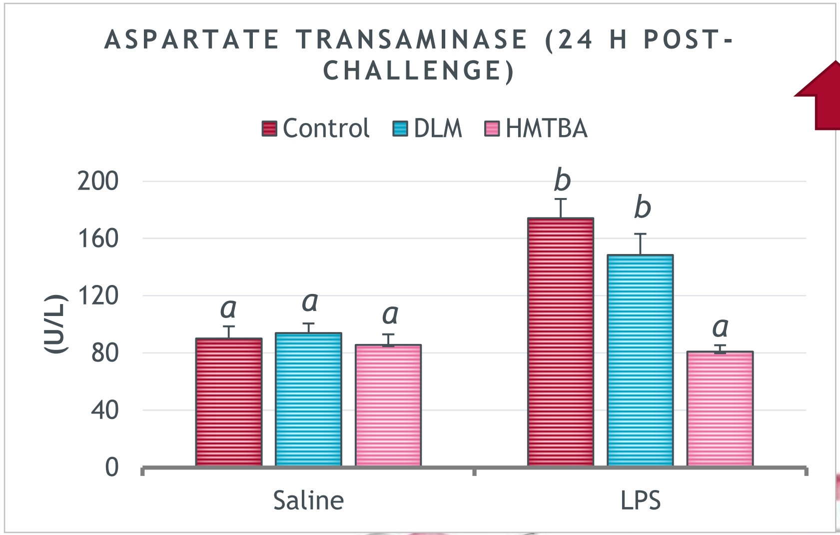
# Albumin and Aspartate transaminase levels in piglets' plasma



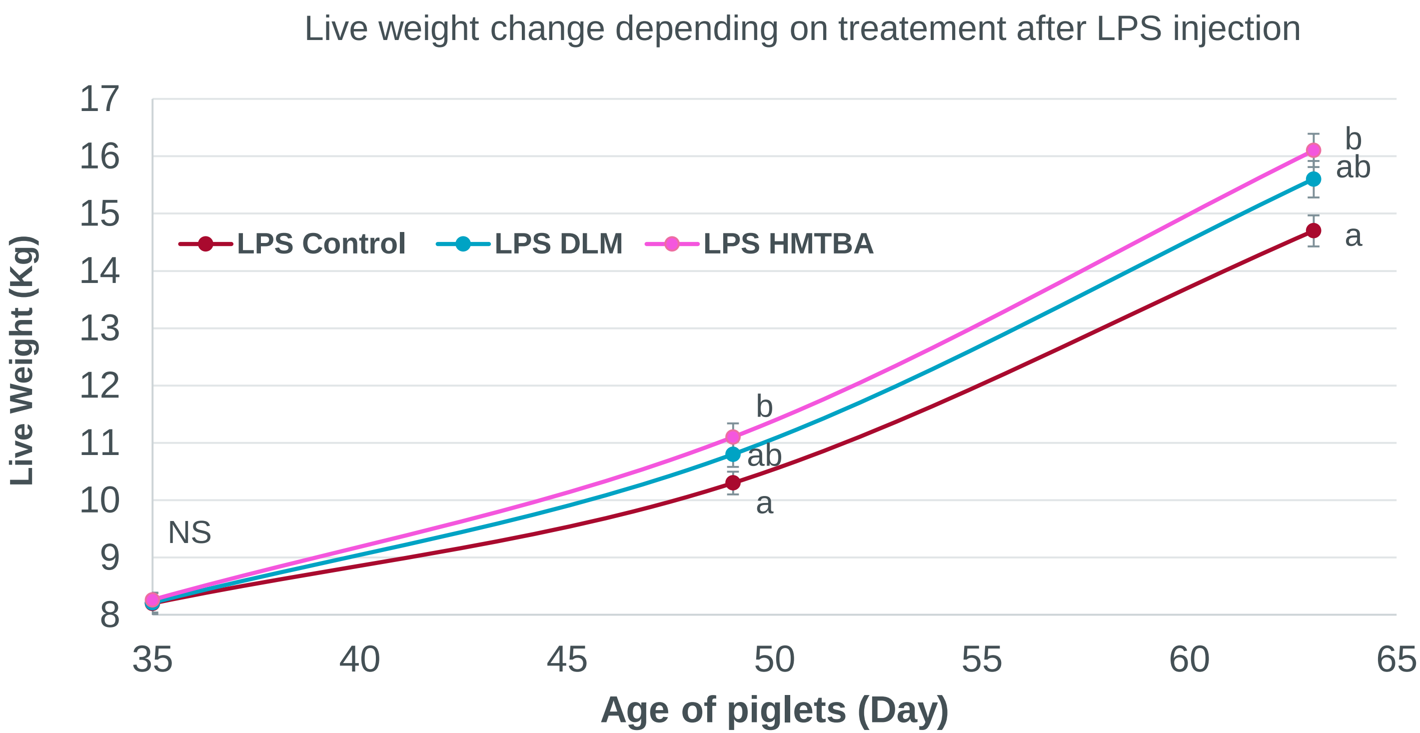

**Albumin decreases in response to inflammatory stress**

**Aspartate transaminase increases with an inflammation**



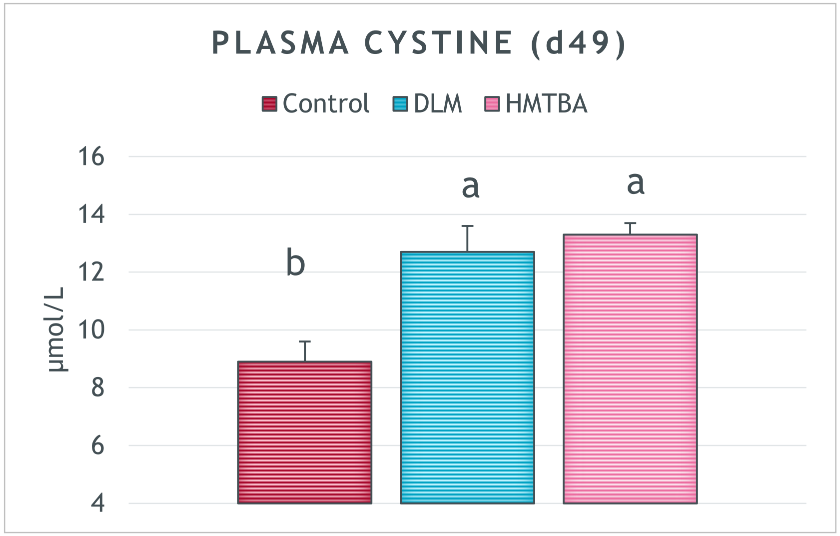
# Improved performance with an increased consumption of Met+Cys under an inflammatory challenge

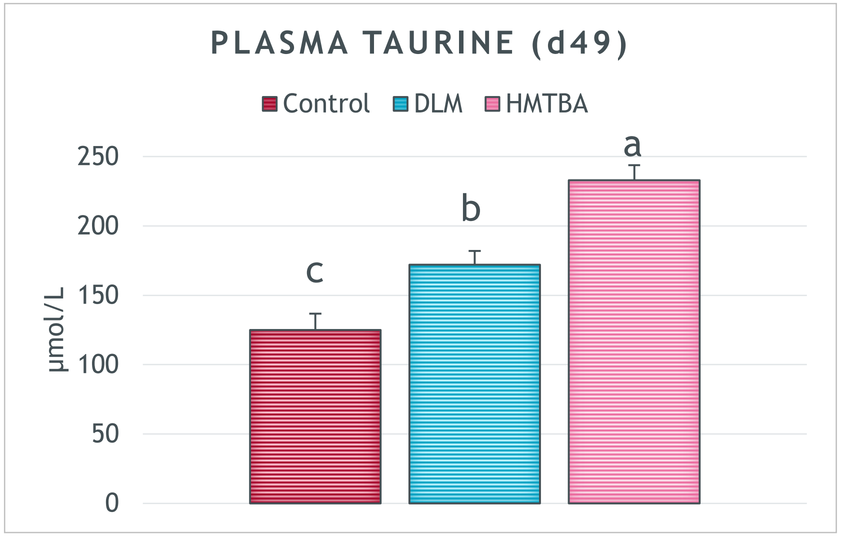


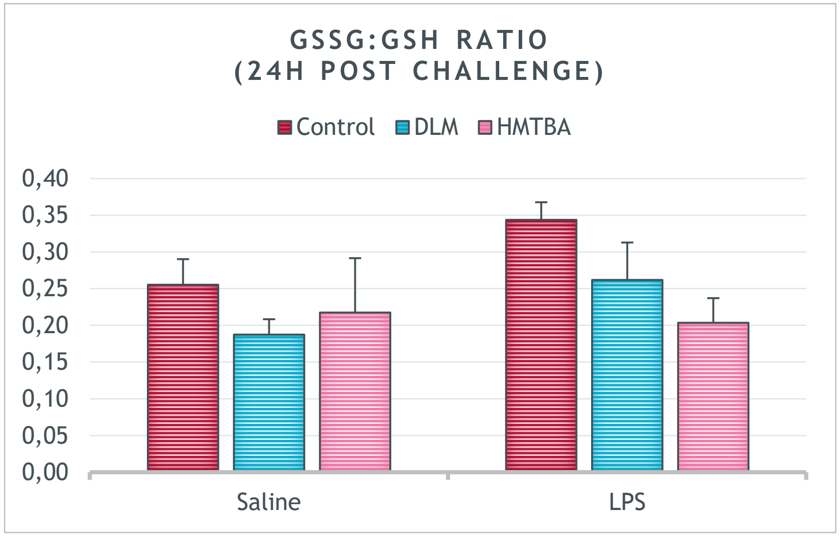

**LPS challenge at 35 day-old affect the growth performance curves**

**Increased Methionine supply allows to partly restore growth depression until 49 day-old**

# Plasma amino acids and glutathione analyses of challenged piglets



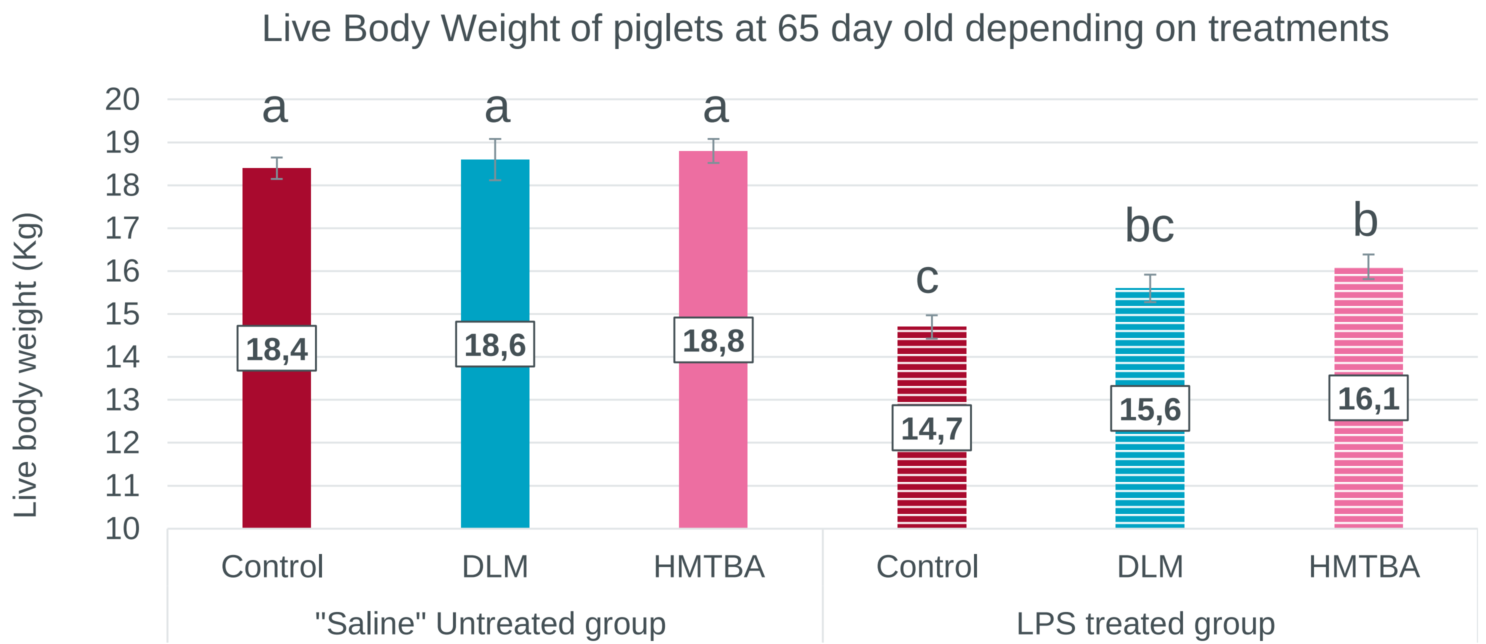




**Cysteine and taurine are known to be implicated in the antioxidant status of the animal.**

**Lower GSSG:GSH ratio → Better antioxidant status with HMTBA**

# Increasing TSAA supply help coping with LPS challenge




**LPS challenge at 35 day-old leads to an average weight loss of 3 Kg at 65 day old**

**Increased Methionine supply allows to recover 0.9 to 1.4 kg respectively with DL-methionine and Hydroxy-methionine**

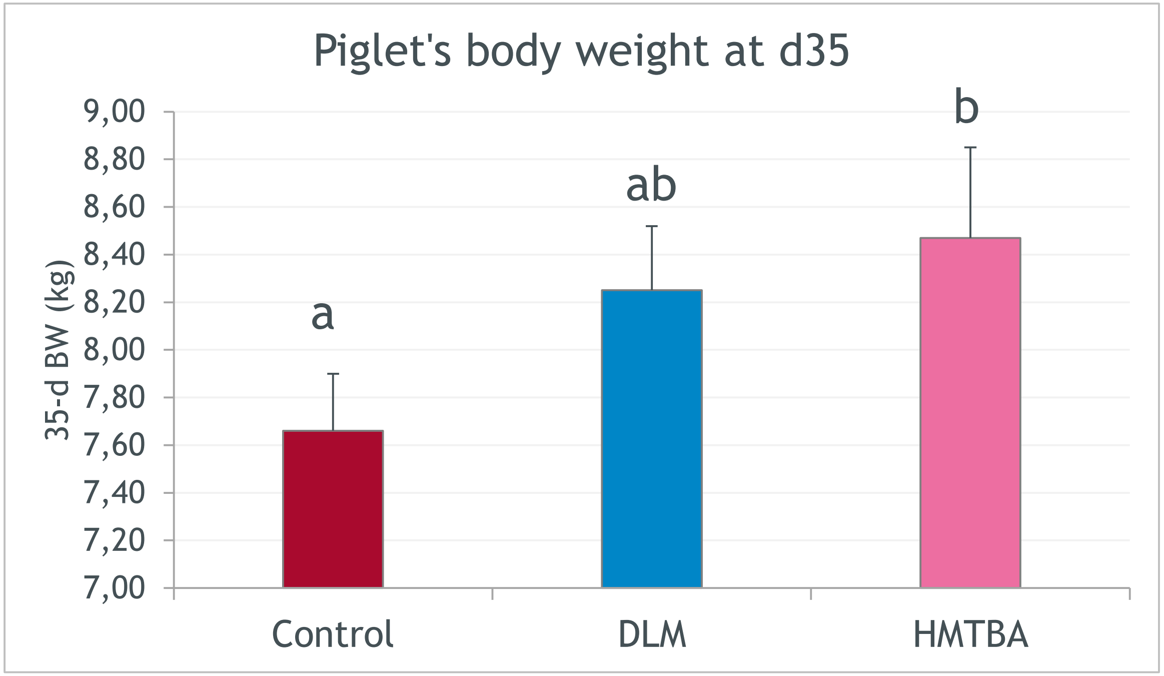
# Take home messages

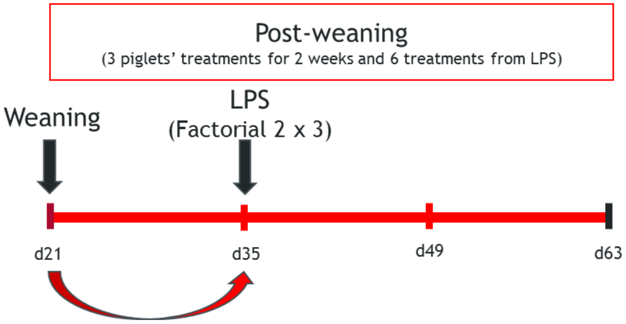
- **For sows :**
  - Increasing TSAA supply during late gestation and lactation improve milk quality (Protein and lactose) and body composition score at the end of lactation.
  - Supplying increased TSAA with Hydroxy-methionine allowed higher improvement than DL-methionine.
- **For piglets :**
  - Improved milk quality allows improving growth performance during lactation
  - Increase TSSA supply during post weaning period help to cope with inflammatory situation by increasing circulating  Cysteine and Taurine and maintain GSSG/GSH Ratio
  - Supplying increased TSAA with Hydroxy-methionine allowed better improvement than with DL-Methionine.

# Thank you for your attention

# Questions ?

# Piglets' performance during the **post-weaning** period




*At 35-d of age (2 weeks of feeding the Exp. Treatments), HMTBA body weight significantly higher than the control*