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# *Incidence of heating the liquid feed on performance of fattening pigs*

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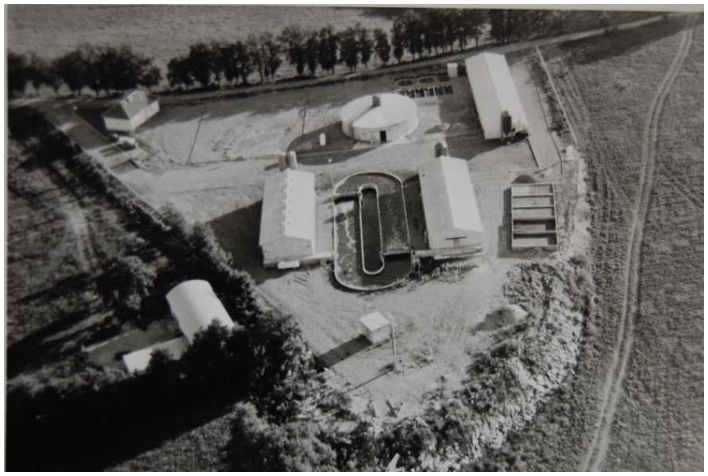
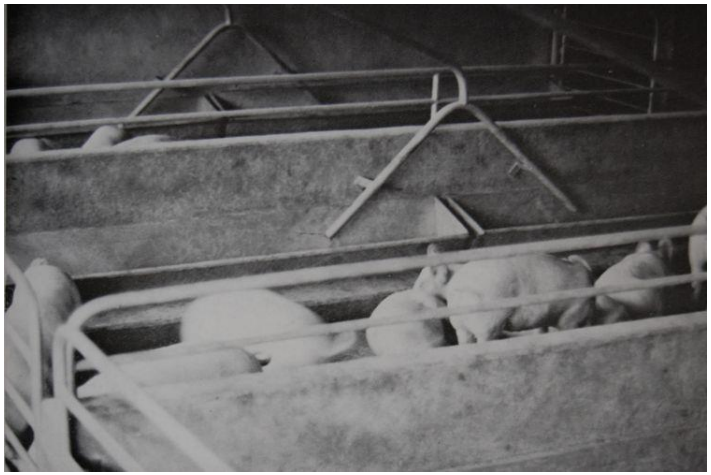
# Heated liquid feed: an old story

- Berek G., 1963 (Poland) quoted by Braude R., 1967
  - Improved performances when warm water is incorporated to liquid feed, in winter
- Swine research Center of Villefranche-de-Rouergue (France), 1969 :
  - Fuel heating system, including liquid feeding





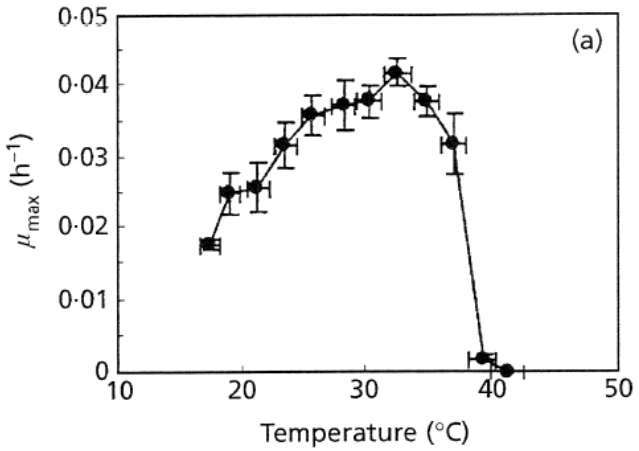
October 1973: first Oil Crisis…

# This matter is poorly documented

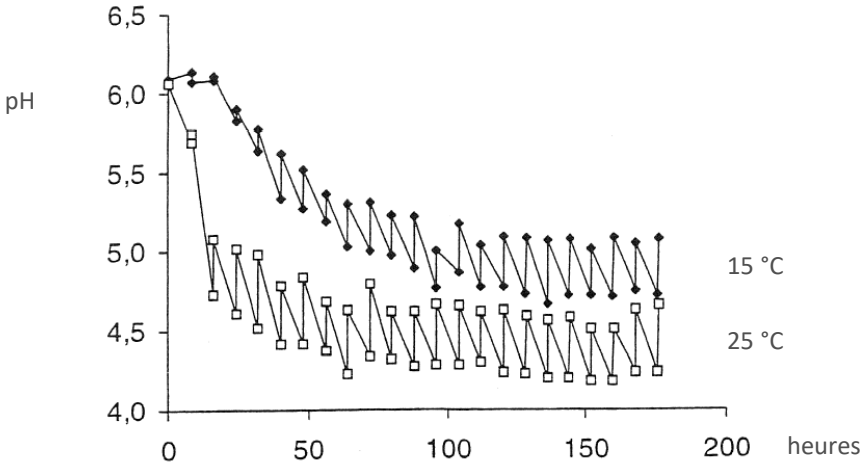
## Numerous studies on temperature and fermentation

- Optimising by-products or silage fermentation
  - Krooneman et al, 2002

Growth rate of *Lactobacillus buchneri*




- Role of temperature on liquid feed fermentation
  - Jensen & Mikkelsen, 1998

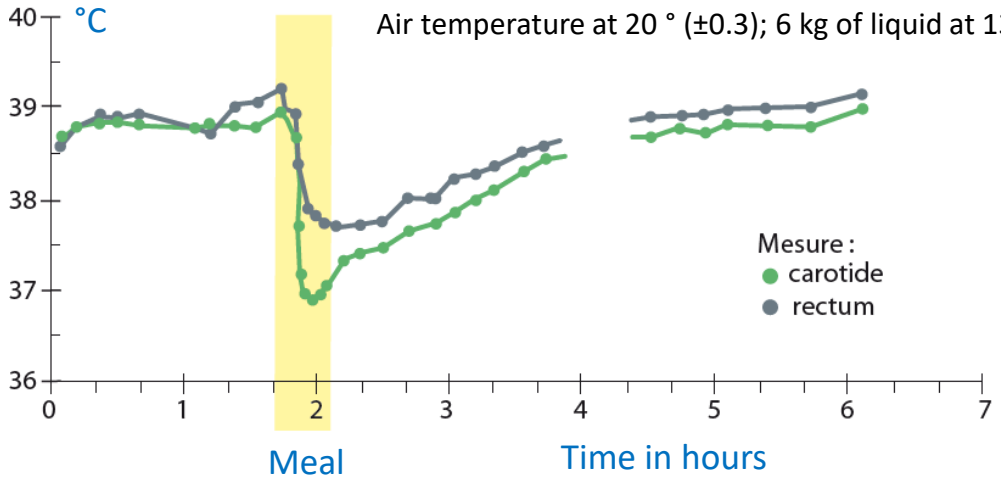



## .. But very little data on temperature of LF distributed

- Little to no references in the scientific databases
- Absent from reference books

# Role of warm liquid feed in internal temperature control?

- Heated LF & homeothermy: hypotheses…
  - Cold < LCT ⇉ feed behaviour & use of energy
  - Energy needed for maintenance ↗ when ° C ↘




*Effect on body temperature of intake of cold skimmed milk (Holmes, 1970)*

- Thermic effect of feeding (heat increment )
  - Metabolisable energy used for tissue synthesis → losses as heat (thermic effect of feed)
  - When ° C ↘ takes part in heat production for thermoregulatory requirements

- Hypothesis: analogy of heated LF with thermic effect of feed ?

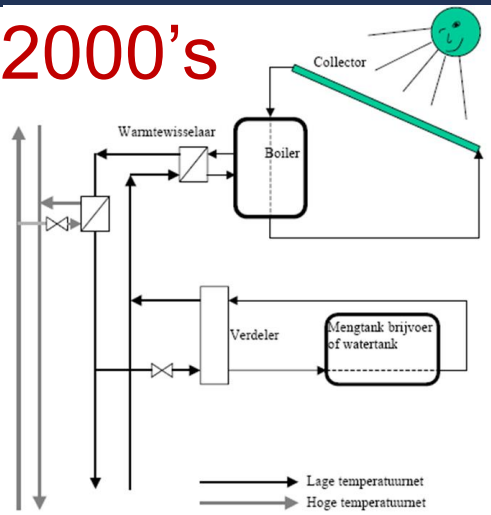
# Role of warm liquid feed in internal temperature control? - 2

- Need of energy to warm a liquid feed
  - No data on animals
  - Approach to warm LF energy calculation.
    - Calorigenic energy needed ↗ LF from 19° to 39° C
      - Thermic Energy for 1 kg water = 4,18 kJ for 1 ° C
      - Thermic Energy for 1 kg corn = 1,12 kJ for 1 ° C

| | Liquid Feeding | | | Required energy | | |
|---|---|---|---|---|---|---|
| Period | ADFI, kg/d | WFR, l/kg | LF, kg/j | Energy kJ | Feed, g/d | % intake |
| Phase 1 | 0.35 | 2.0 | 1.1 | 70 | 5 | 1.6% |
| Phase 2 | 1.0 | 2.3 | 3.3 | 226 | 18 | 1.8% |
| Growing | 2.2 | 2.8 | 8.4 | 590 | 46 | 2.1% |
| Finishing | 2.8 | 3.0 | 11.2 | 797 | 62 | 2.2% |

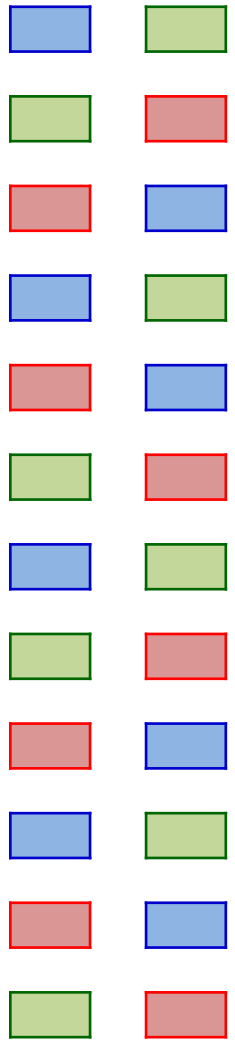
# Context : renewable energies & LF heating

- Development Netherlands, Belgium in 2000's
  - Warm water need:
    - Heating floors or panels
    - Warm water shower
- And elsewhere in Europe ?
  - Energy-producing farms
    - Heat pumps
    - Biomass Heaters
    - Methane units
- Renewed interest in heated LF
  - Modern liquid feeding systems can adjust ° C
  - Some use for piglet weaning in Europe
  - Interest for fattening pigs ?



# Growing-finishing performance study

- Experimental design
  - 72 females & 72 barrows (LWxLD)xPiétrain
    - 10 weeks of age (27.5 ± 3.6 kg)
    - 1 trial × 3 treatments
  - 3 temperatures of liquid feeding
    - Medium 20° C
    - Cold 10° C
    - Hot 30° C
- Housing temperature = 24° C



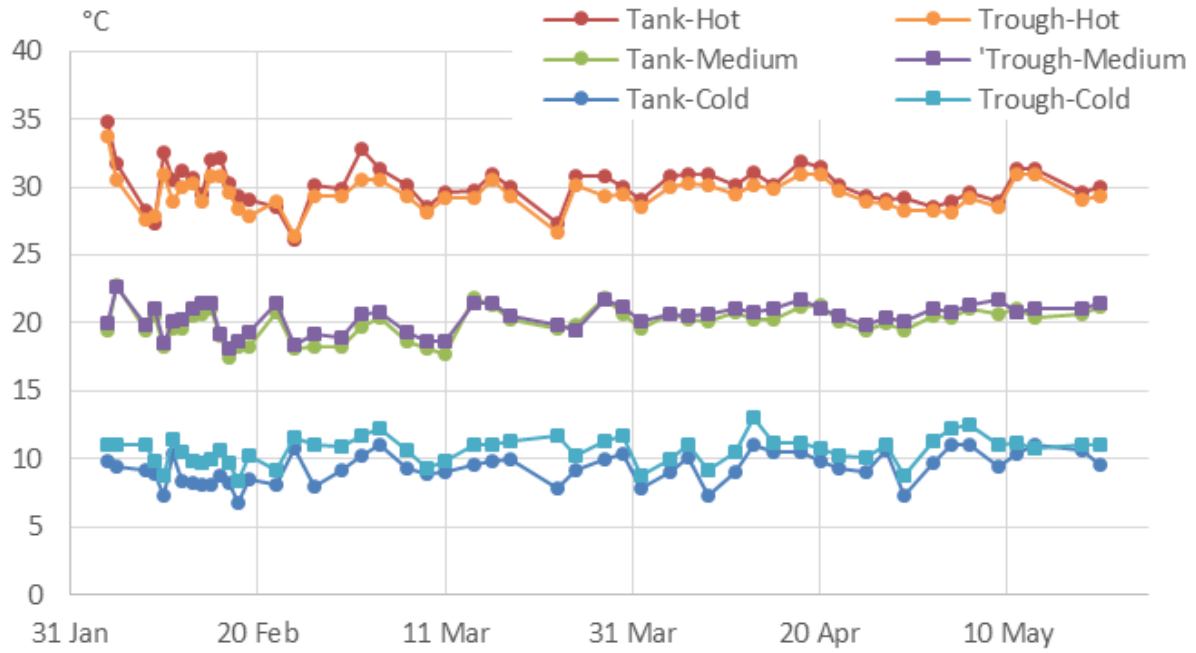
# Materials and methods

- Swine Research Center: Villefranche-de-Rouergue (France)
  - Precision liquid feeding equipment
    - Low capacity tank (500 kg)
    - Mixing per internal pump & agitators
    - Feed as a column with positioning water
    - Distance from pump to 1$^{rst}$ valve: 11 m, to last valve :33 m
  - 1 circuit x 24 valves ⇒ 24 pens x 1 trough x 6 places
- Restricted distribution at 08:30 and 16:00
  - according to plan (growing period) then up to 2.6 kg/d (barrows) and 2.5 kg/d (females)
  - Water feed ratio: 2.7:1 then 2.9:1 l/kg
  - Feed intake monitored twice a day

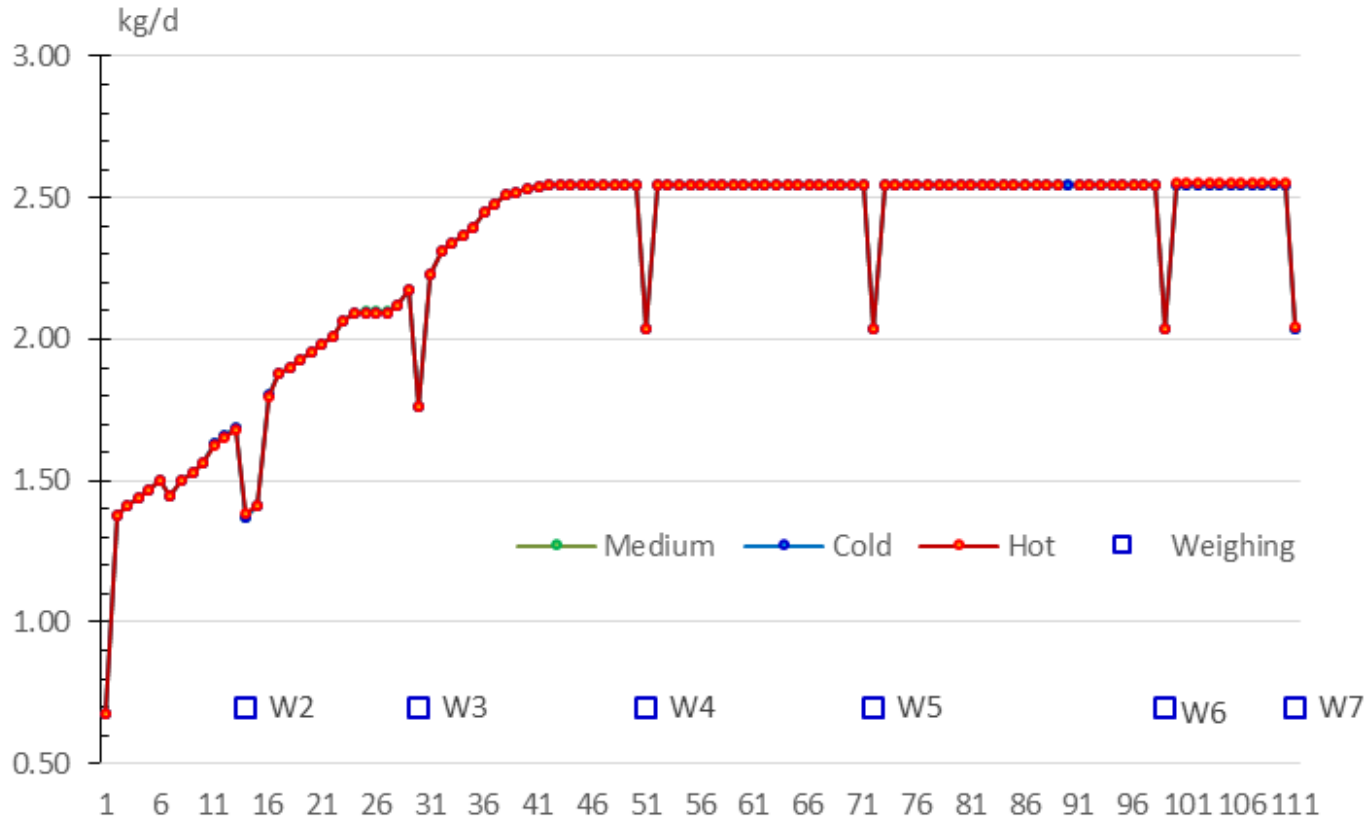
# Results

## Mixing and distribution temperatures

- Daily measurements in the mixing tank and troughs



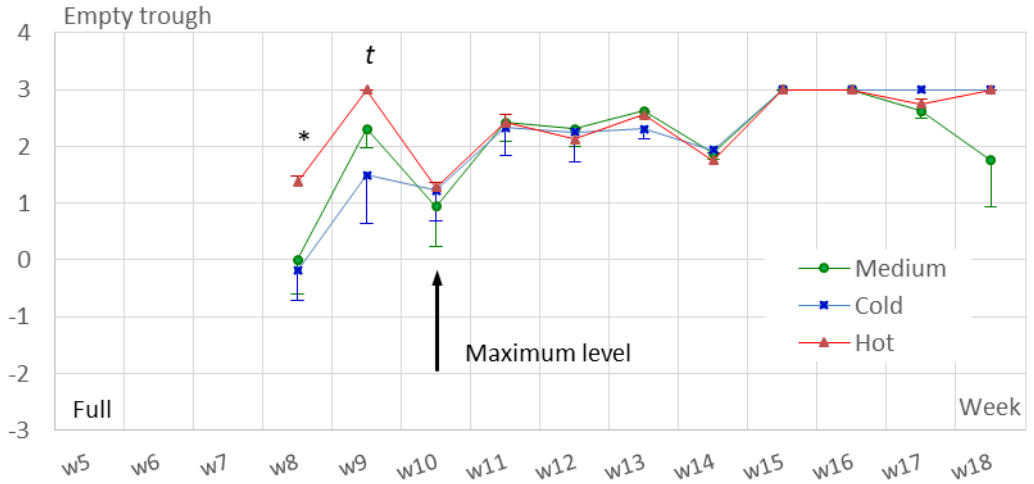
## Daily Feed Intake



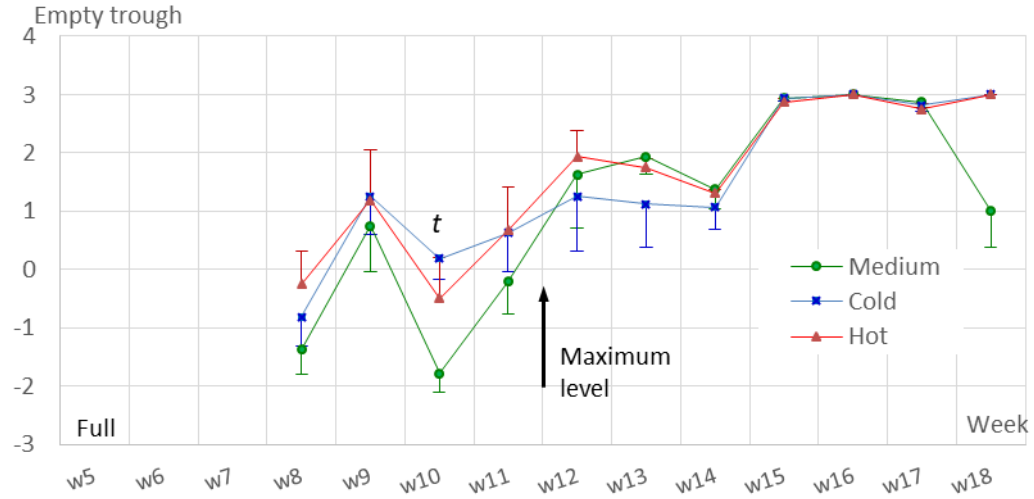
# Results

- Speed of intake
  - Notes of emptying of the trough 30 minutes after the distribution

- Barrows

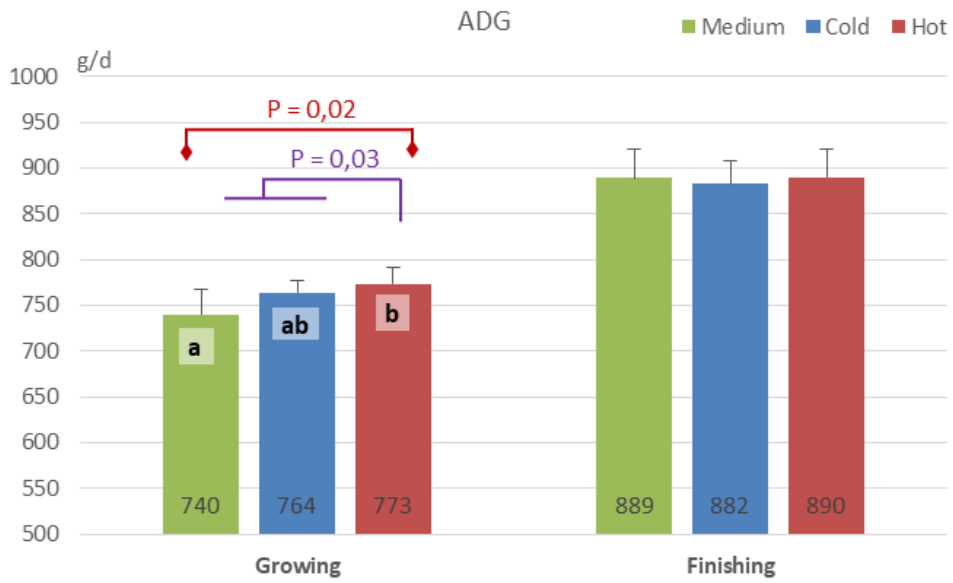


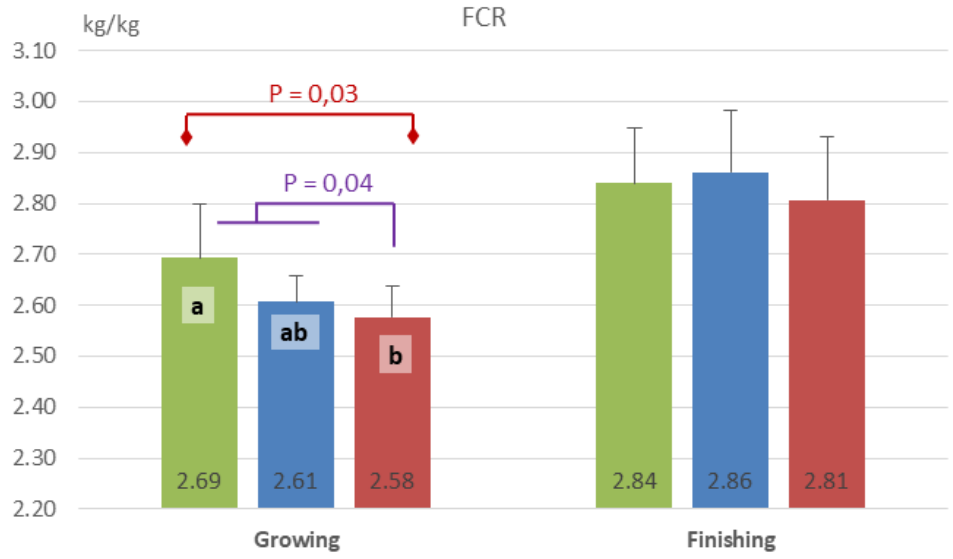

- Females



# Results : animal performance for growing and finishing periods

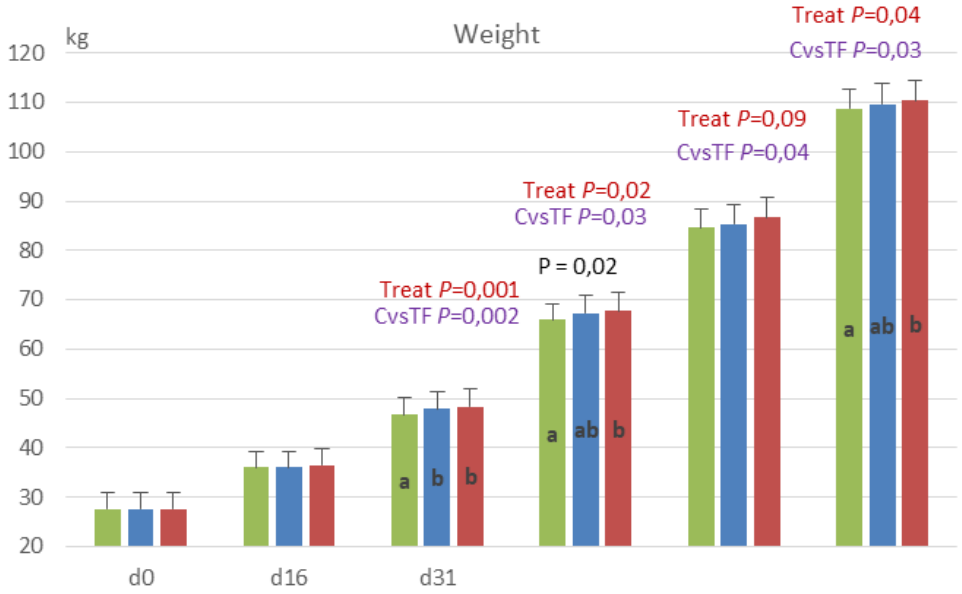
- ADG
  - Growing period
    - Hot vs Medium: +4.4%
    - Cold vs Medium: +3.1%
  - Finishing period
    - NS
- FCR
  - Growing period
    - Hot vs Medium: -4.2%
    - Cold vs Medium: -3.2%
  - Finishing period
    - NS

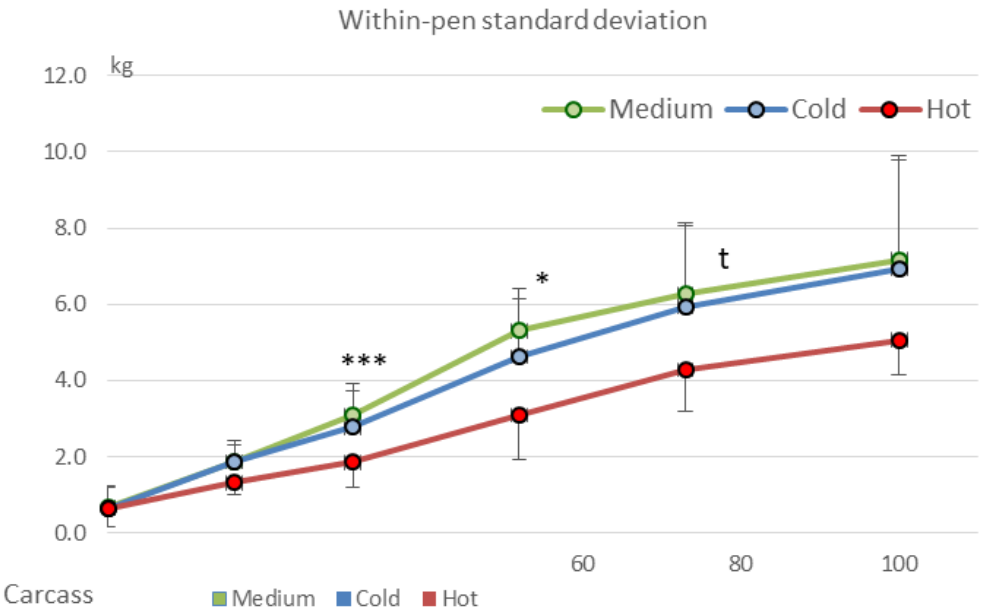


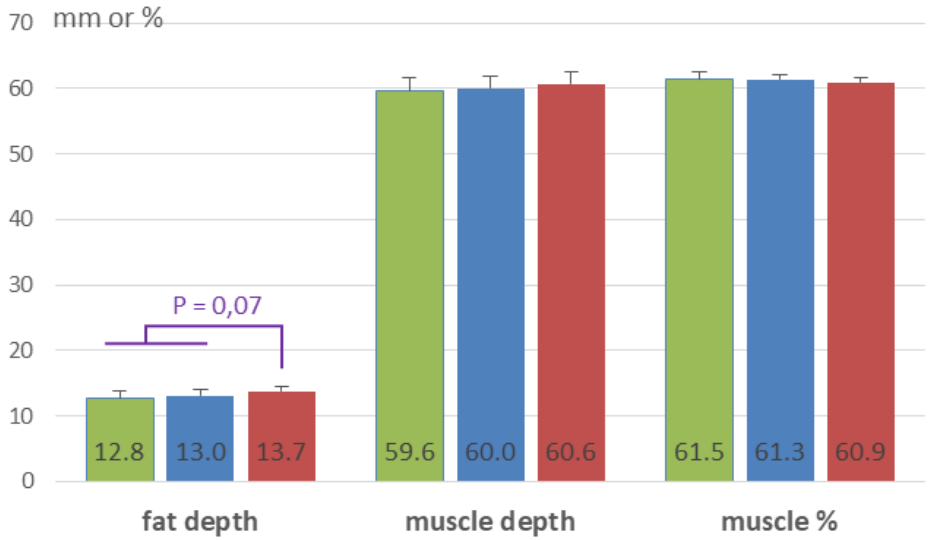
# Results

## Evolution of live weight & pen weight heterogeneity




## Carcass results



# Discussion : performance

- Heated liquid meal for fatteners ?
  - growing period [growth limited by energy intake] : ↗ performance
  - finishing period [growth limited by protein deposition] : = performance ≥ fat depth
  - Literature (according to plan; Housing < 23° C)
    - Improved performance [Forbes & Walkers, 1968, trial 1; Holmes, 1971, trials 1&2; Koomans & Mertens, 1973, trials 2&4; Anonymus quoted by Jost, 1986]
    - Similar performance [Forbes & Walkers, 1968, trial 2; Koomans & Mertens, 1973, trials 1&3]
  - Effect on digestive health ?
    - influence of LF over diarrhoea in finishers (surveys by Hansen et al, 2001; Pedersen and Ibsen, 2003)
- Higher interest for weaners….
  - Role of warm LF on feeding behaviour

# Discussion : performance

- Lower gastric emptying rate ?
  - Meal or brevage ºC → stomach ºC (Sun et al, 1988). In mammals, thermoreceptors of gastrointestinal mucosa can inhibit gastroduodenal motility (El Ouazzani and Mei, 1979, El Ouazzani, 1984; Cotrell et al, 1984).
  - In humans, ↘ gastric emptying with an iso-osmotic beverage at 4 ºC or 50 ºC (Sun et al, 1988). Cold drink → number of antro-pyloric pressure waves, → isolated contractions of pylorus, ↗ transient decrease in gastric myo-electrical activity after the meal (Tougas et al, 1992; Sun et al., 1995, Verhagen et al., 1998).
  - But ≠ other regulations of gastric emptying
  - Hypothesis, differences in nutrient digestibility ↔ unexpected good performance result of the **COLD menu** ?
- Lower speed of intake?

# Conclusions

- Need for more research
  - Expectedly, feed conversion ratio improved by heated meal
  - Unexpectedly, gastric emptying or intake speed influenced by cold meal
- Renewed interest in heated LF
  - Modern liquid feeding systems
  - Energy-producing farms
  - Opinion of farmers ?

# THANKS YOU

## Aknowledgments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