Genetic parameters of body temperature in laying hens exposed to chronic heat

WHY DO WE NEED HEAT RESISTANT HENS?

World Egg Production (FAOSTats, 2012)

Frequency of heat waves in Europe (Fischer and Schär, 2010)

Selection programs of Laying hens in optimally controlled conditions
Production performance vs. Thermal tolerance

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HEAT DISSIPATION IN HENS

Convection
Conduction
Radiation

Evaporation

SENSIBLE HEAT LOSS

Sensible heat loss
Evaporative heat loss

Proportion of heat loss (%)
Temperature (°C)

Anderson and Carter, 2007
MATERIALS AND METHODS

- 2 genotypes of commercial laying hens
- 12 pens of 200 birds: 8 collective pens and 4 pens with individual nests
- 2 stress treatments: 6 stressed pens and 6 control pens
- 3 floor pens per genotype and per stress group
MATERIALS AND METHODS

- 6 cycles of chronic heat at 35 week of age

Thermography measures
MATERIALS AND METHODS

- Hens placed in a wooden box, pictures taken with FLIR B335 camera

- Analyses done with ThermaCam Pro 2.1 software

- Mean shank temperature
- Mean comb temperature
- Mean wing temperature
STATISTICS

- Proc GLM of SAS used to check significant effects to include in the model
- VCE6 with an animal model used to estimate genetic parameters
  - Fixed effect of pen (N=12)
  - Fixed effect of heat stress treatment (heat vs normal)
  - Age of the hen
  - Ambient temperature of the pen
  - Number of pictures taken per bird (1 or 2)
  - Random direct genetic effect of animal

Line A (5588 pictures)  Line B (9355 pictures)

Lower number of birds due to cannibalism

Genetic parameters

(Normal + Hot)

Normal  Hot

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Results
Examples of pictures when it works ... and when it does not

19.6°C  28.4°C
Results
Genetic parameters

Heritability estimates

Line A (Thermo-neutral+Hot)
Line B (Thermo-neutral)
Line B (Hot)

Wing  Shank  Comb
Results

Genetic Correlations with shank temperature

- Egg Weight
- Egg Width
- Yolk weight
- Shell weight
- Haugh Unit*
- LAB yolk
- LAB shell
- Static Stiffness
- Meat & Blood spots
- Belly feathering
- Back feathering

28-30°C 18-20°C
Conclusions

- Heritability estimates:
  - Wing → Low heritability
  - → Surface temperature reflects environmental temperature

Shank and comb → higher heritability estimates
  → Heat dissipation partly under genetic control

- Birds with poor plumage = less heat dissipation by shank

- Surface temperature is correlated with egg quality under heat stress

- Infrared thermography, a pertinent tool for phenotyping heat dissipation
Thank you for your attention

Thank you genetics!