



Effect of thermal manipulation during incubation of slower-growing broiler chickens on chick quality and later life behaviour and resilience

PPILOW seminar

21st of May 2024

Evelien Graat

Why thermal manipulation during incubation?

- Varying effects on hatchability, chick quality and body weight
- Improved thermoregulation (Yahav et al., 2004)
- Improved resistance to heat or cold (Yalçın et al., 2010 and 2012; Shinder et al., 2011; Zaboli et al., 2017)
- Increased fear with lower incubation temperature (Bertin et al., 2018; Verlinden et al., 2022)

Can a variable temperature/environment during incubation make slower growing broilers more resilient to change during their life?



Early life at WUR - Experimental design

Breed: Hubbard I657

Study 1 – Early life

Control (C): constant eggshell temperature of **37.8°C**

Thermal treatment (TM): from embryonic day 9-16 the temperature changed every 12 hours

High/Low (HL)

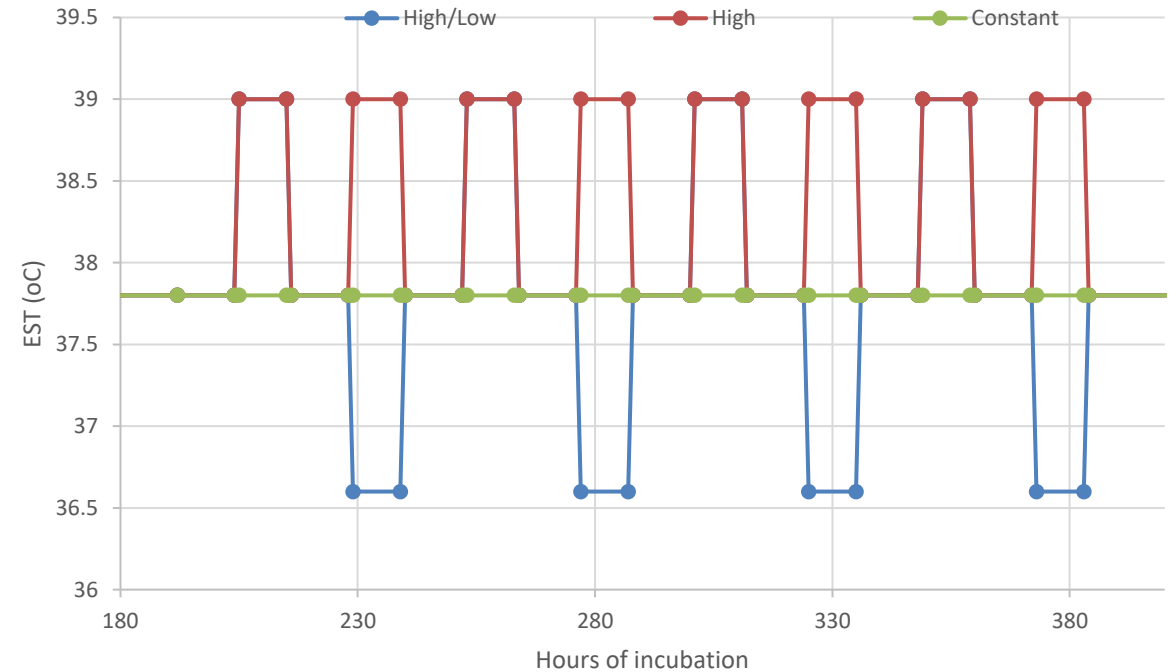
37.8°C – 38.9°C – 37.8°C – 36.7°C

High (H)

37.8°C – 38.9°C

Study 2 – Later life

Treatment Control and High/Low applied



Study 1 - Measurements

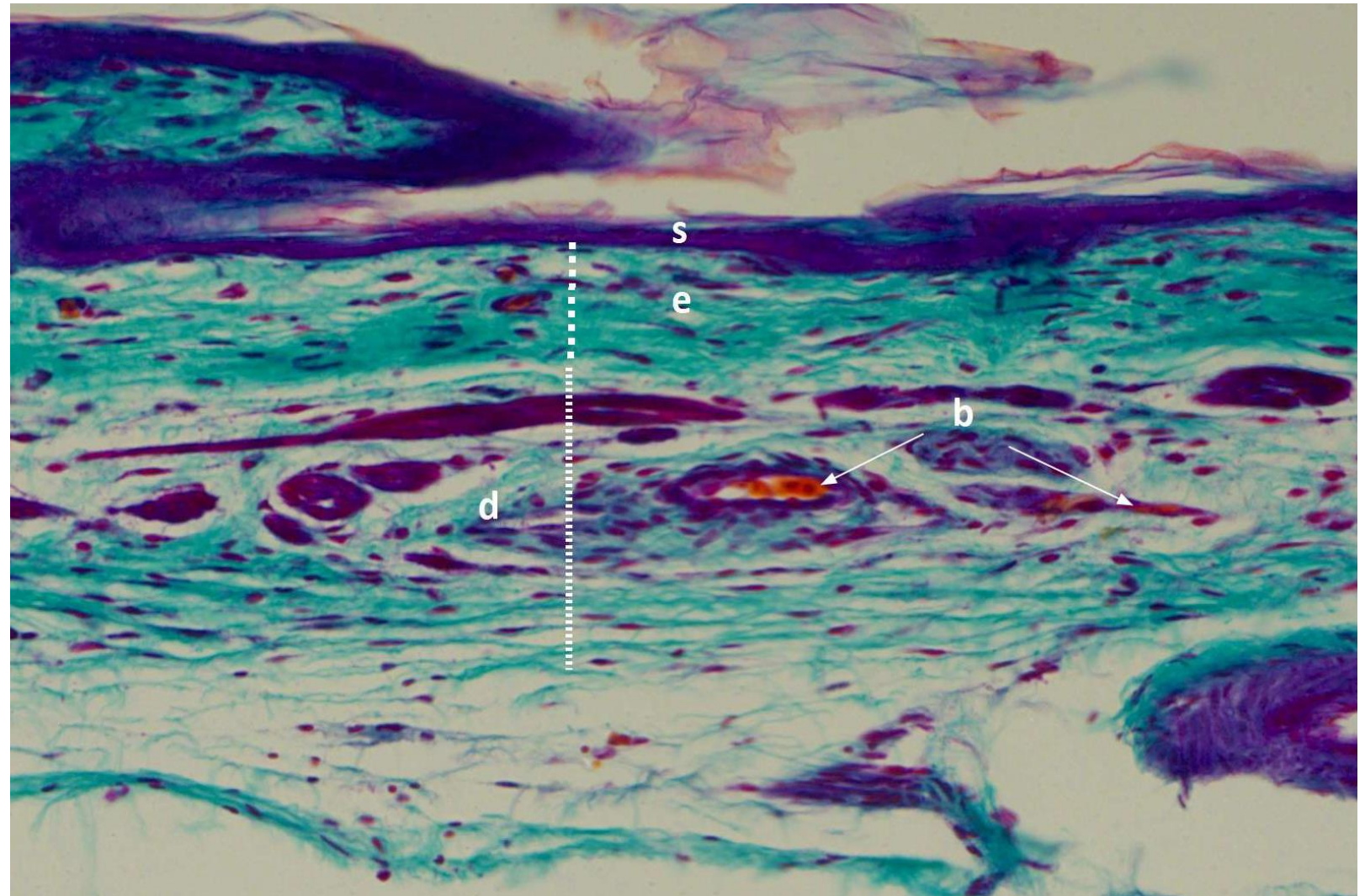
Heat production

Chick quality

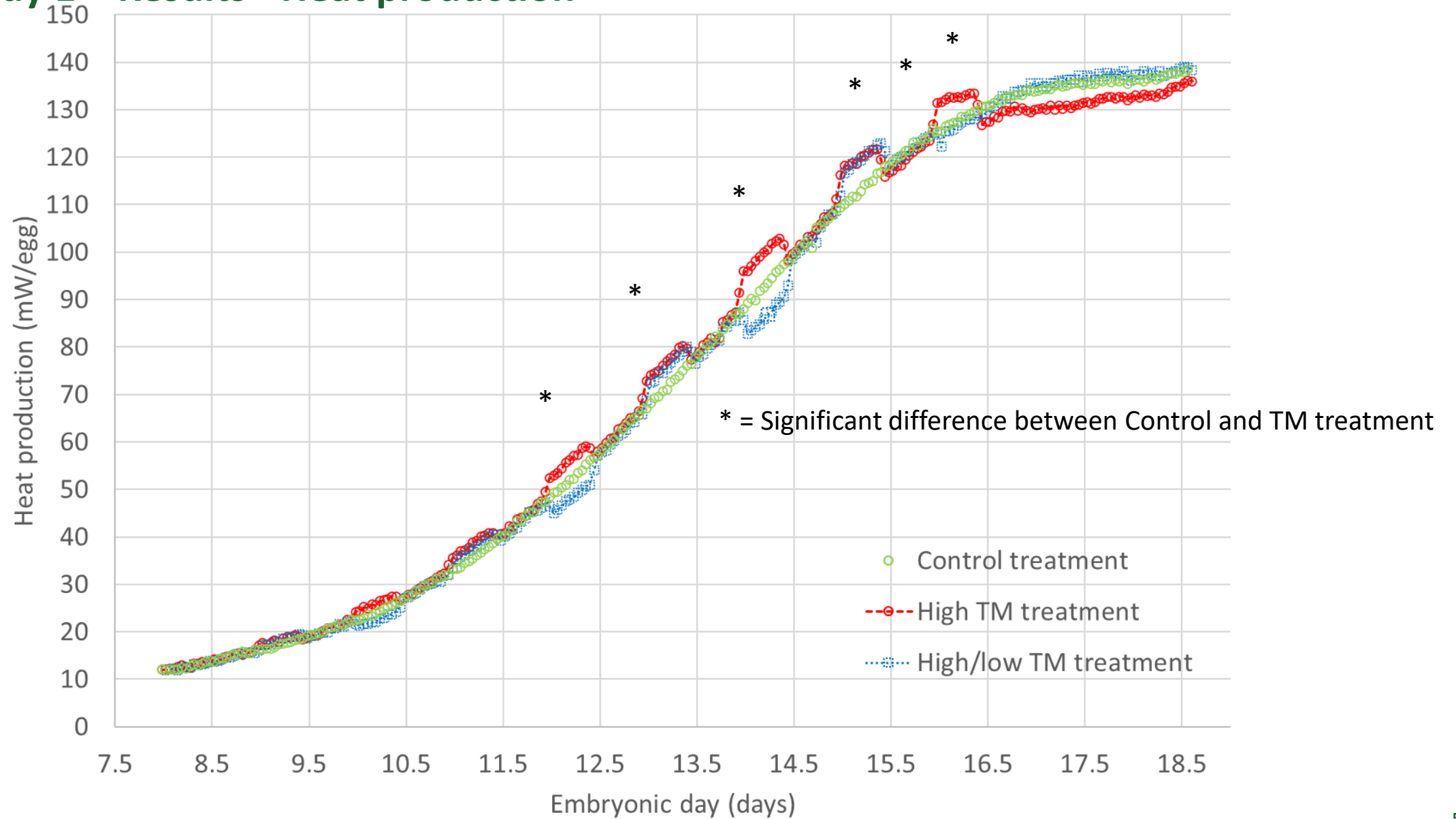
Skin development

Thickness of
s = stratum cornea
e = epidermis
d = dermis

Number/Perimeter
b = blood vessel



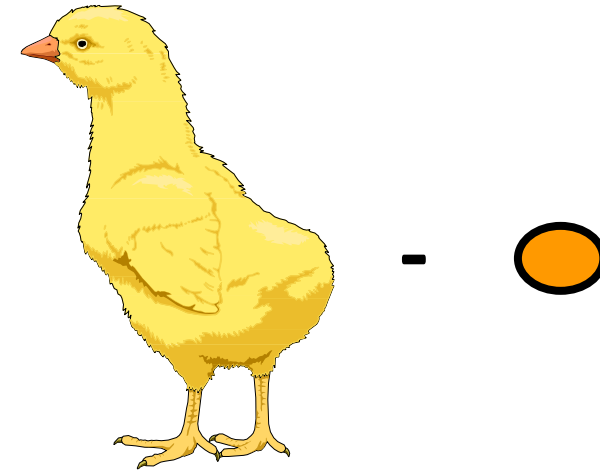
Study 1 – Results - Heat production



Study 1 – Results - Chick quality

Parameter	Control	High	High/ Low	SEM	P-value
Hatch time (hrs)	498	493	497	2	0.44
Body weight (g)	40.8	40.7	40.8	0.18	0.95
YFBM (g)	36.4	35.9	36.3	0.21	0.42
Residual yolk (g)	4.50	4.80	4.52	0.13	0.32
Heart (% of YFBM)	0.77	0.70	0.75	0.03	0.34
n	52	54	59		

Yolk-free body mass
Body weight minus Residual yolk weight

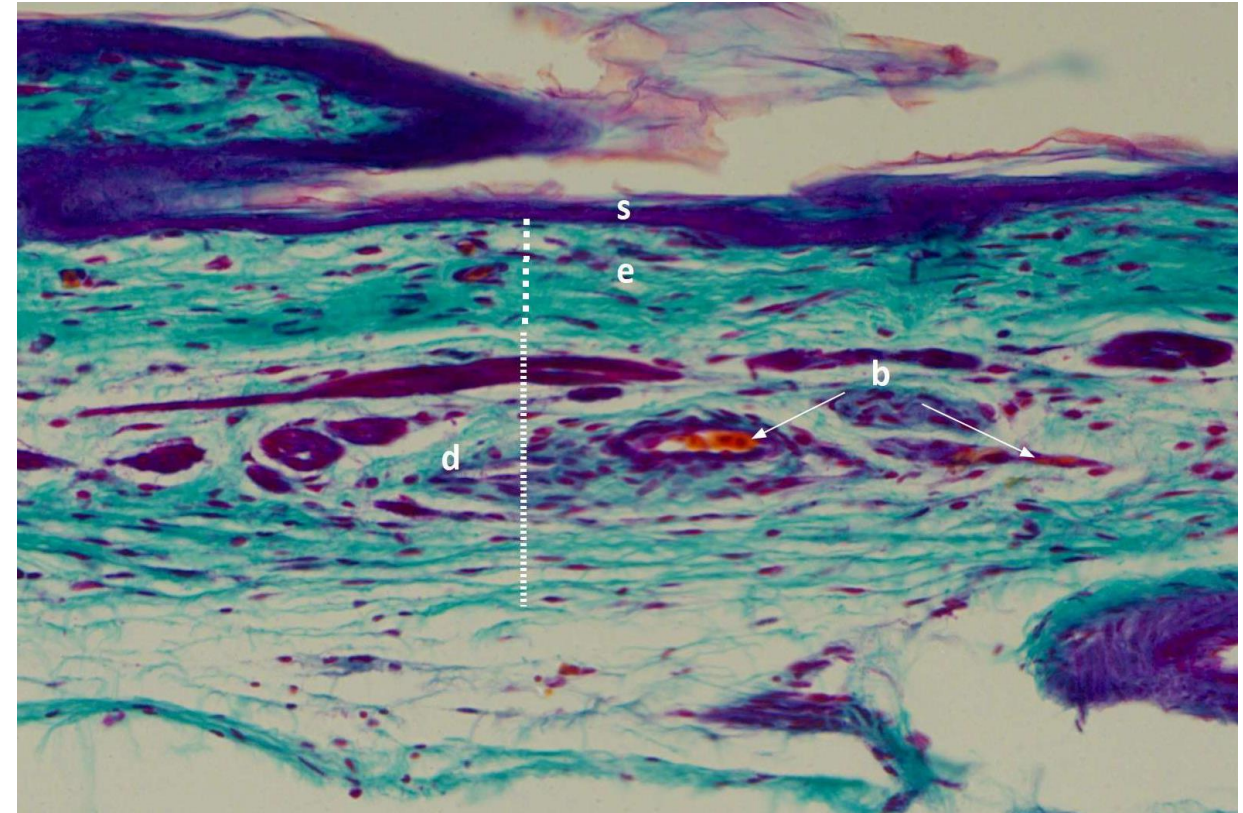


No difference in chick quality between treatment groups



Study 1 – Results - Skin development

Parameter	Control	High	High/ Low	SEM	P-value treatment
Skin					
Str corneum (µm)	10	10	9	0.7	0.88
Epidermis (µm)	35	38	39	2.6	0.58
Dermis (µm)	74	75	85	7.1	0.57
Blood vessel ratio	9.0	8.6	8.9	0.54	0.91
Vessel perim (µm)	18	17	18	2.2	0.94
n	13	11	13		



No difference in skin development between treatment groups

Later life at ILVO - Housing



2x2 groups of 100 chickens

Later life at ILVO - Housing



2x2 groups of 100 chickens



Stable compartment:

- 9.6m²
- 3 feeders
- 3 drinkers
- Perches



Winter garden:

- 72m²
- Enriched with operant larvae feeders

Study 2 – Body weight and FCR - Measurements

Chickens weighed:

- Day 1 (all individuals, mann-whitney U test)
- Day 21 (group weight + subset, 95% CI intervals)
- Day 55 (group weight + subset, 95% CI intervals)
- Day 79 (all individuals, 95% CI intervals)

Feed weighed:

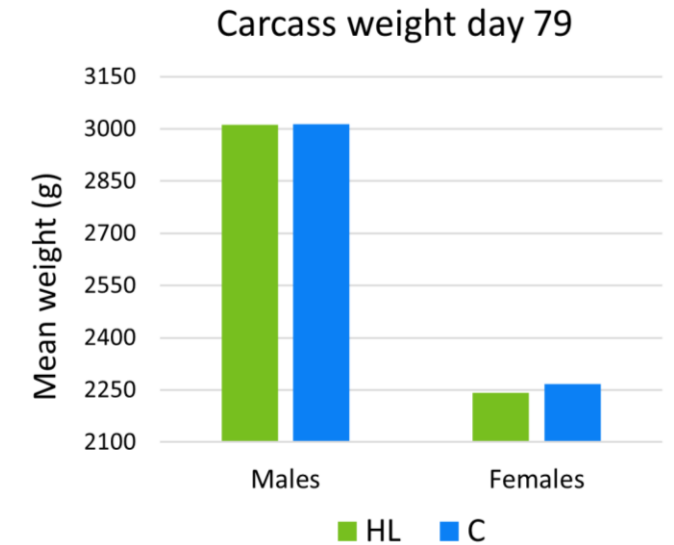
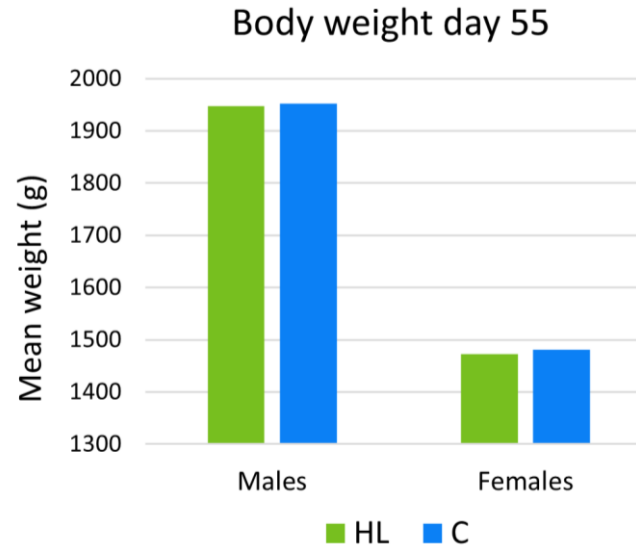
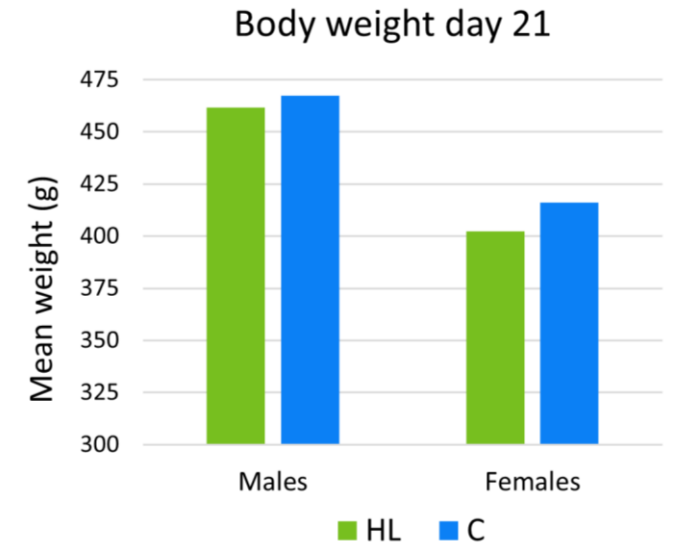
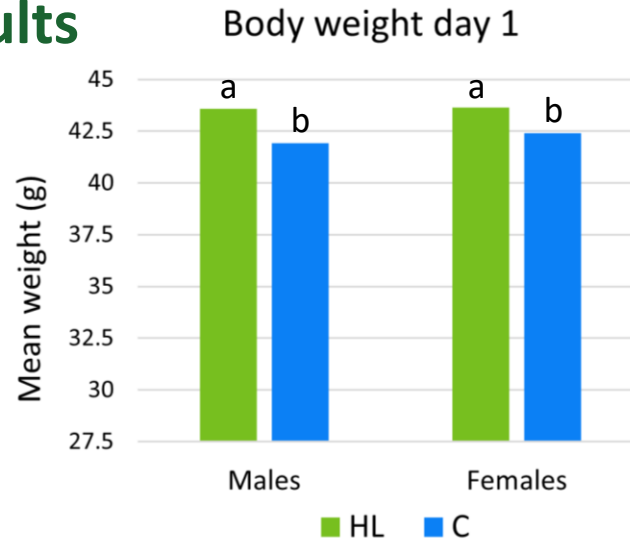
- Day 21 (P1)
- Day 55 (P2)
- Day 79 (P3)

Feed conversion ratio = total feed consumed / total weight gain

Study 2 - Body weight - Results

Day 1: Males $p < 0.01$; Females $p = 0.02$

Day 21, 55, 79: All 95% CIs overlapped



Day 1: **HL** n = 102 males and 100 females; **C** n = 101 males and 97 females

Day 21: **HL** n = 18 males and 14 females; **C** n = 16 males and 16 females

Day 55: **HL** n = 16 males and 12 females; **C** n = 14 males, 14 females

Day 79: **HL** n = 79 males and 79 females; **C** n = 82 males and 77 females

Study 2 - Feed conversion rate - Results

	Feed intake (g/chicken/day)	Growth (g/chicken/day)	Feed conversion ratio
High/low	79.57	33.12	2.40
Control	78.94	33.45	2.36
1657 Hubbard Company	71.89	28.2	2.53

No clear difference between treatments

Study 2 - Heat stress – Set up

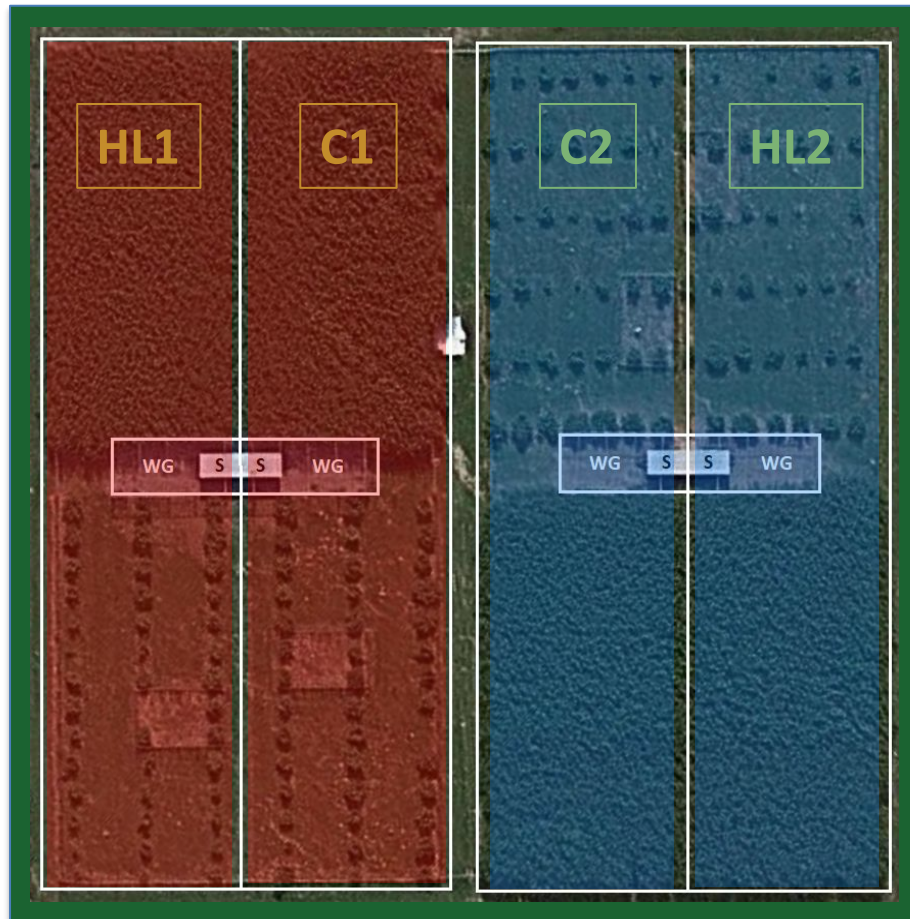


Acute heat stress (day 48 or 49): 3 hours at $30^{\circ}\text{C} \pm 2^{\circ}\text{C}$

n=9

13

Study 2 - Heat stress – Set up



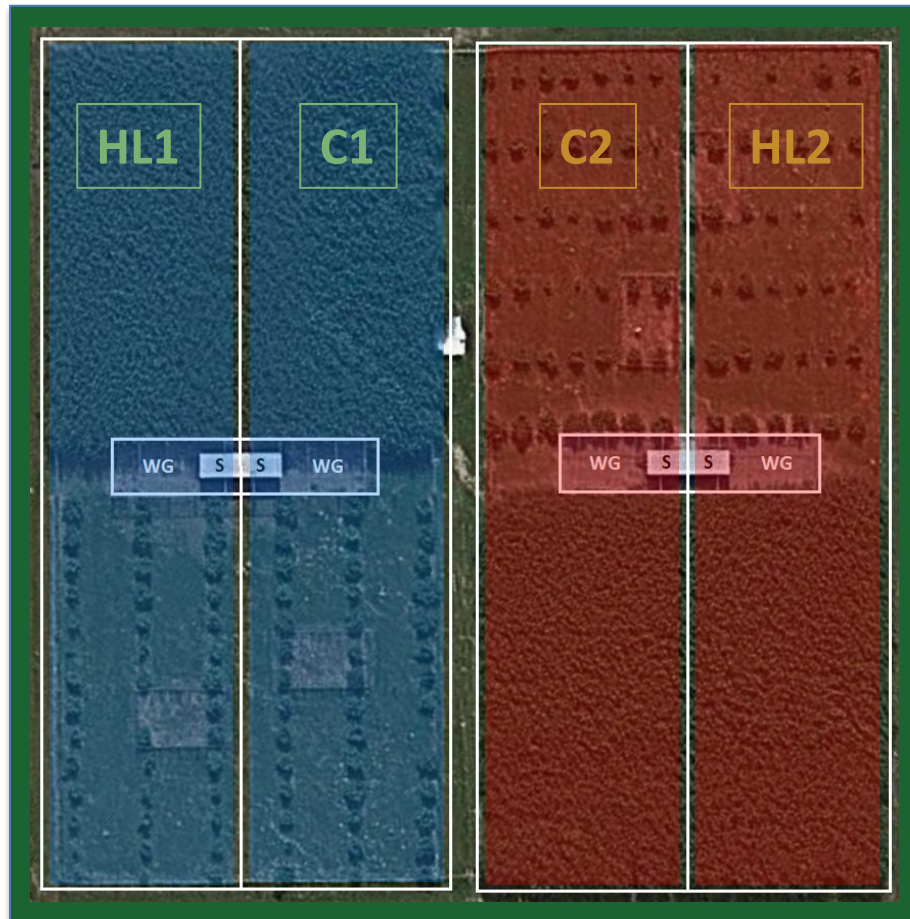
Acute heat stress (day 48 or 49): 3 hours at $30^{\circ}\text{C} \pm 2^{\circ}\text{C}$

Day 48: Heat stress HL1 and C1 + Control day HL2 and C2

n=9

14

Study 2 - Heat stress – Set up



Acute heat stress (day 48 or 49): 3 hours at $30^{\circ}\text{C} \pm 2^{\circ}\text{C}$

Day 48: Heat stress HL1 and C1 + Control day HL2 and C2

Day 49: Heat stress HL2 and C2 + Control day HL1 and C1

Compare heat stress and control day per group

n=9

15

Study 2 - Heat stress – Measurements



Behaviour (group level)

- During 3 hours of heat stress
- Behavioural scan every 3 minutes:
 - Locomotion/standing/perching/resting (1 per bird)
 - Eating/drinking/foraging (1 per bird)
 - Aggressive pecking/positive interaction/wing raising/wing flapping/dust bathing (ad libitum)

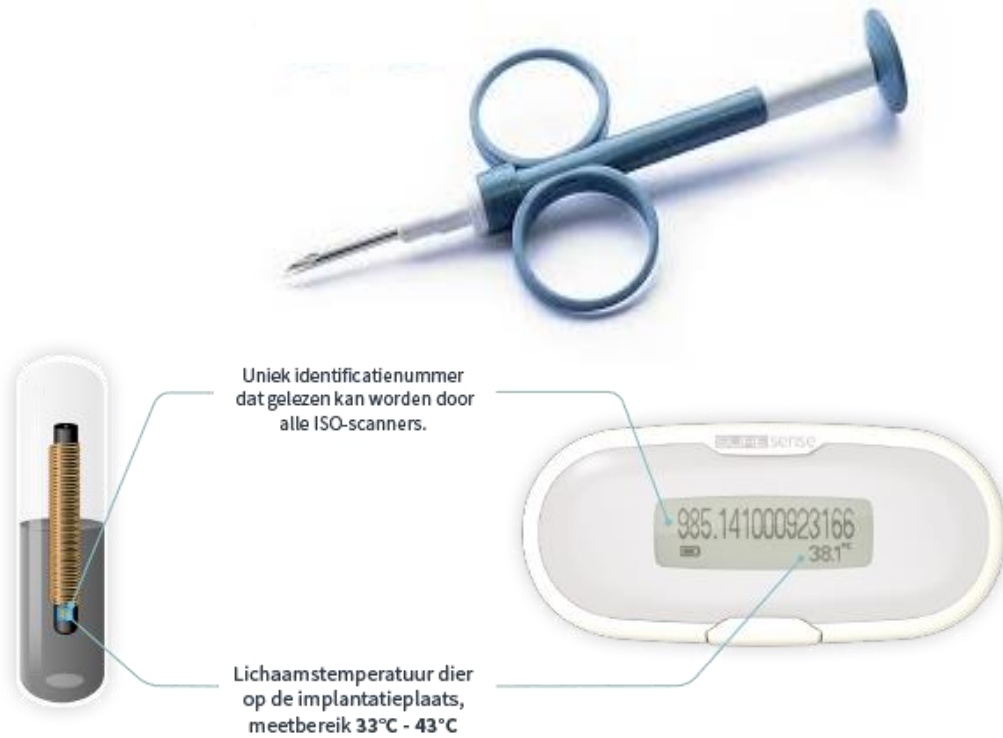
Analysis:

- Visual comparison of group level data

Study 2 - Heat stress – Measurements

Behaviour (group level)

Body temperature (28 chickens per treatment)



Study 2 - Heat stress – Measurements

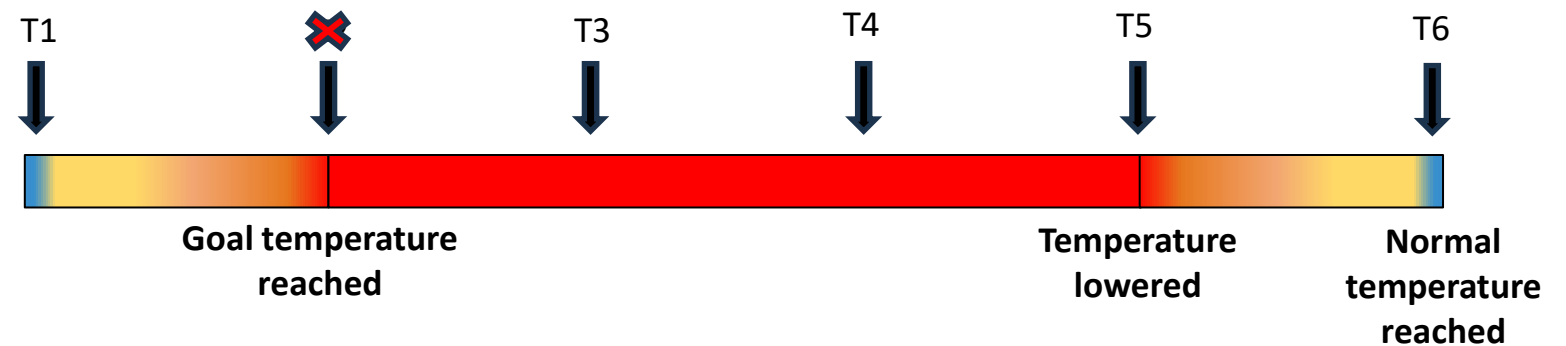


Behaviour (group level)

Body temperature (28 chickens per treatment)

- Baseline (T1)
- Goal temperature reached (T2)
- Every hour with raised temperature (T3, T4, T5)
- Every hour until normal temperature is reached (T6)

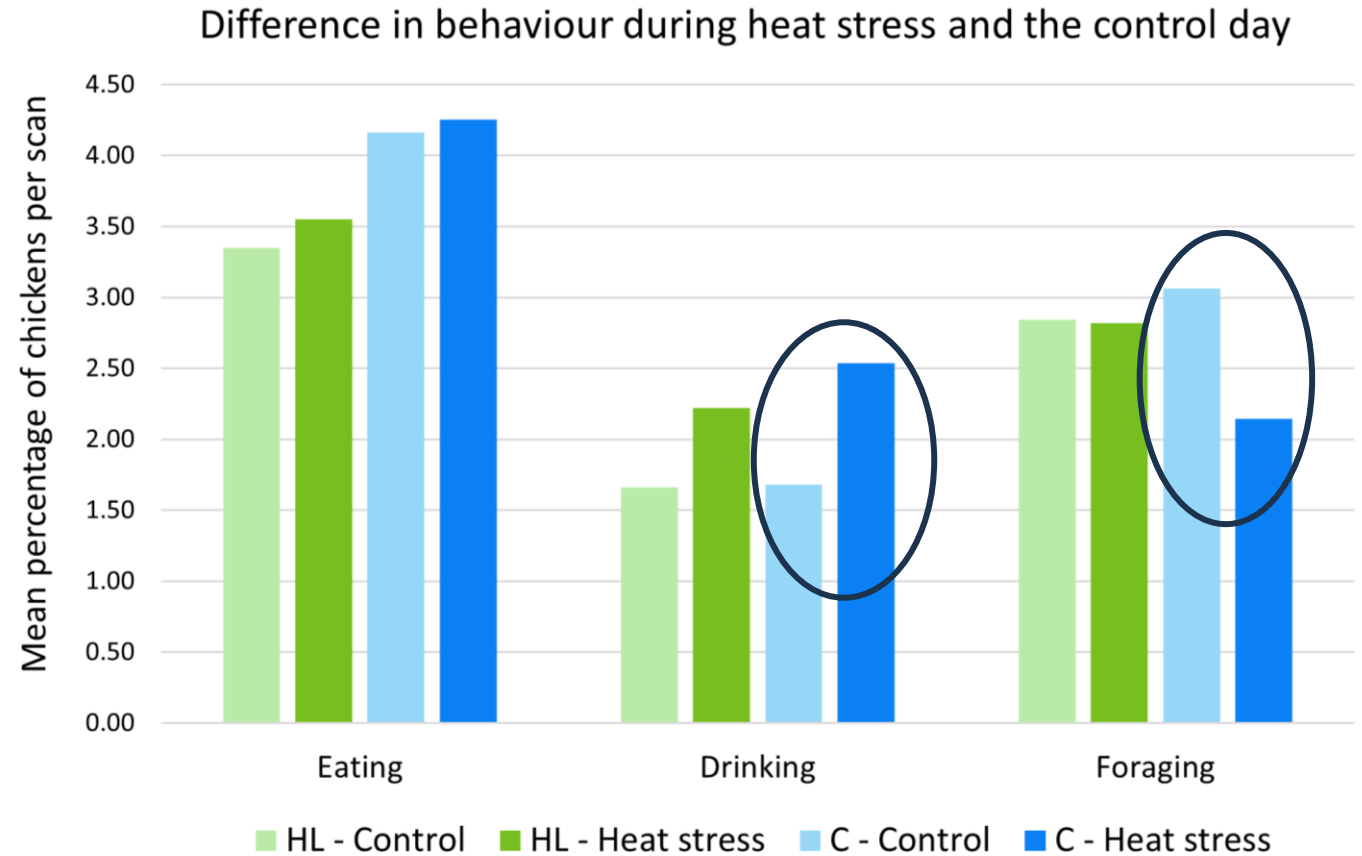
Analysis: comparison of 95% CIs of the difference per moment



Study 2 - Heat stress – Results

“Drinking” increased more for the control group

“Foraging” decreased for the control group



HL: n = 2; 198 chickens C: n = 2; 195 chickens

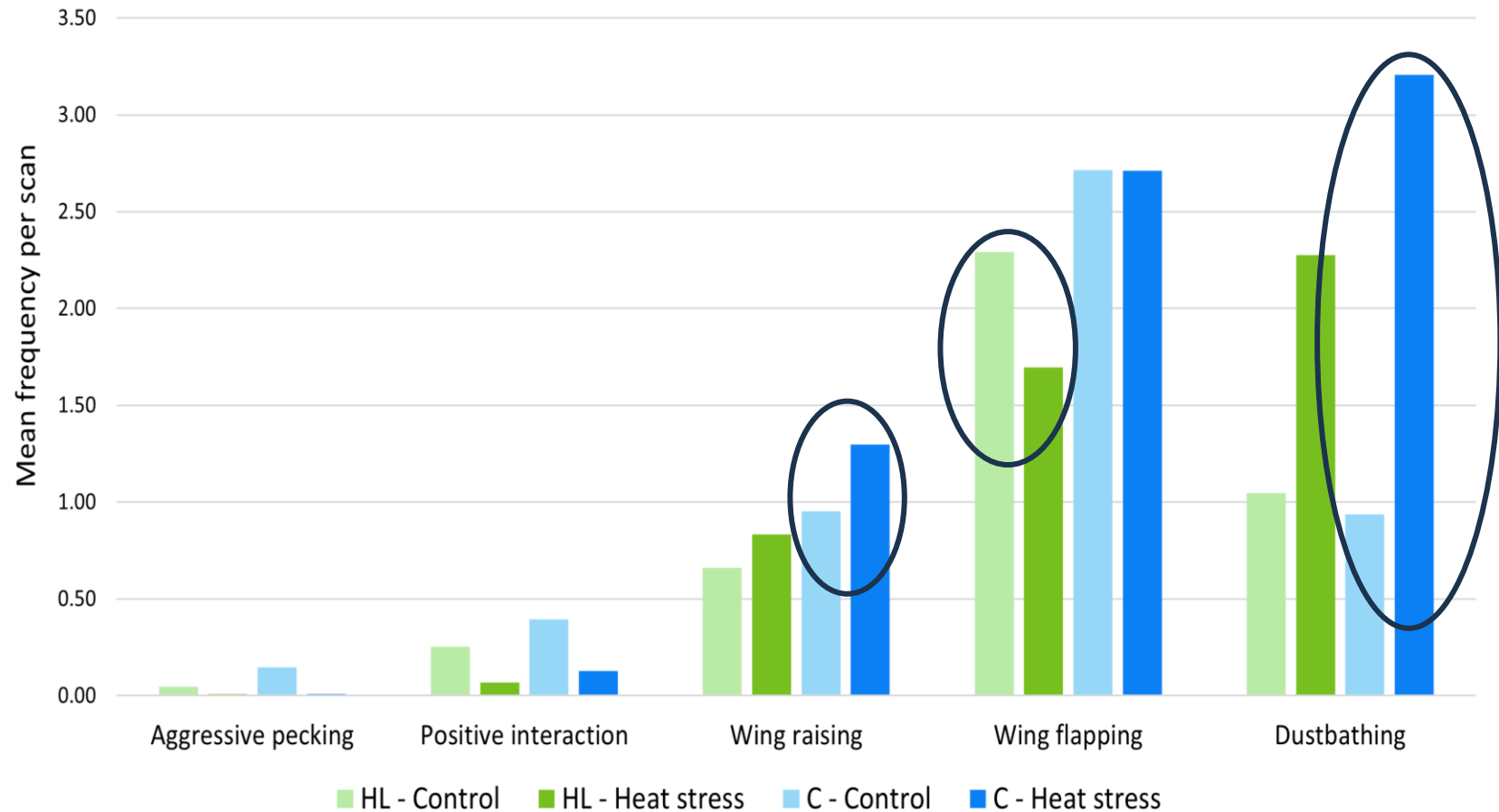
Study 2 - Heat stress – Results

“Wing raising” increased more for the control group

“Wing flapping” decreased for the high/low group

“Dustbathing” increased more for the control group

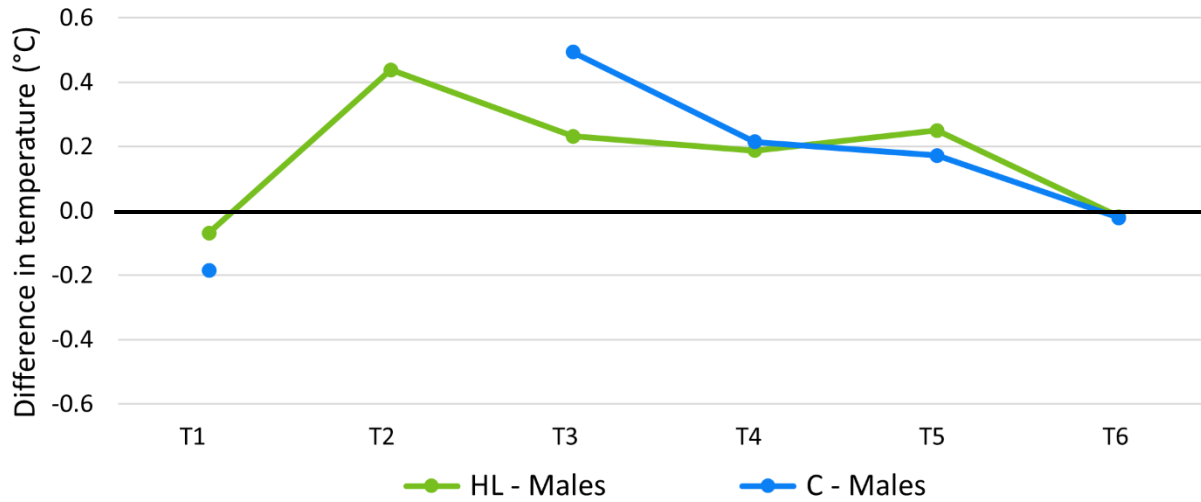
Difference in behaviour during heat stress and the control day



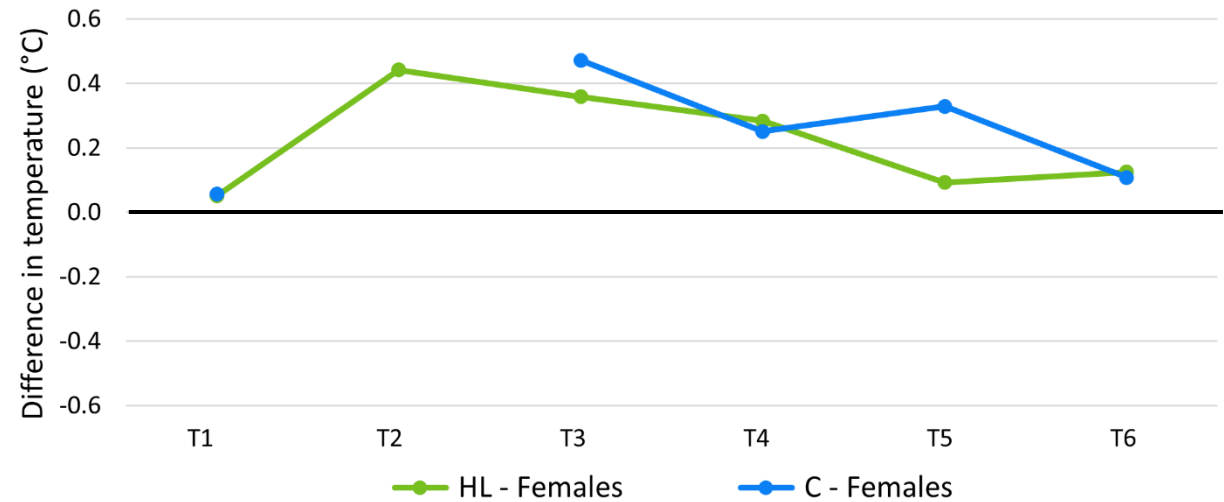
HL: n = 2; 198 chickens C: n = 2; 195 chickens 20

Study 2 - Heat stress – Results

Difference in body temperature during heat stress and control day - males



Difference in body temperature during heat stress and control day - females



95% confidence intervals overlapped for all moments

HL: n = 16 males and 12 females; C: n = 14 males, 14 females

Early life (Study 1)

- No effect of thermal manipulation on chick quality or skin development
- Heat production was instantly affected by thermal manipulation

Later life (Study 2)

- The incubation treatment affected chick weight, but did not affect body weight or the feed conversion ratio later in life
- There is some indication that the behaviour of chickens with a variable incubation temperature was less affected by heat stress
- Data did not support that the incubation treatment affected body temperature during heat stress
- Follow-up research with more repetitions and replications could help answer remaining questions

Thank you to the partners involved:

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Thijs Decroos (ILVO)
Bas Rodenburg (UU)
Anne Collin (INRAE)



Contact: evelien.graat@ilvo.vlaanderen.be

roos.molenaar@wur.nl

www.ppilow.eu