

A new PLF sensor aiming for reducing broilers' body temperature fluctuations

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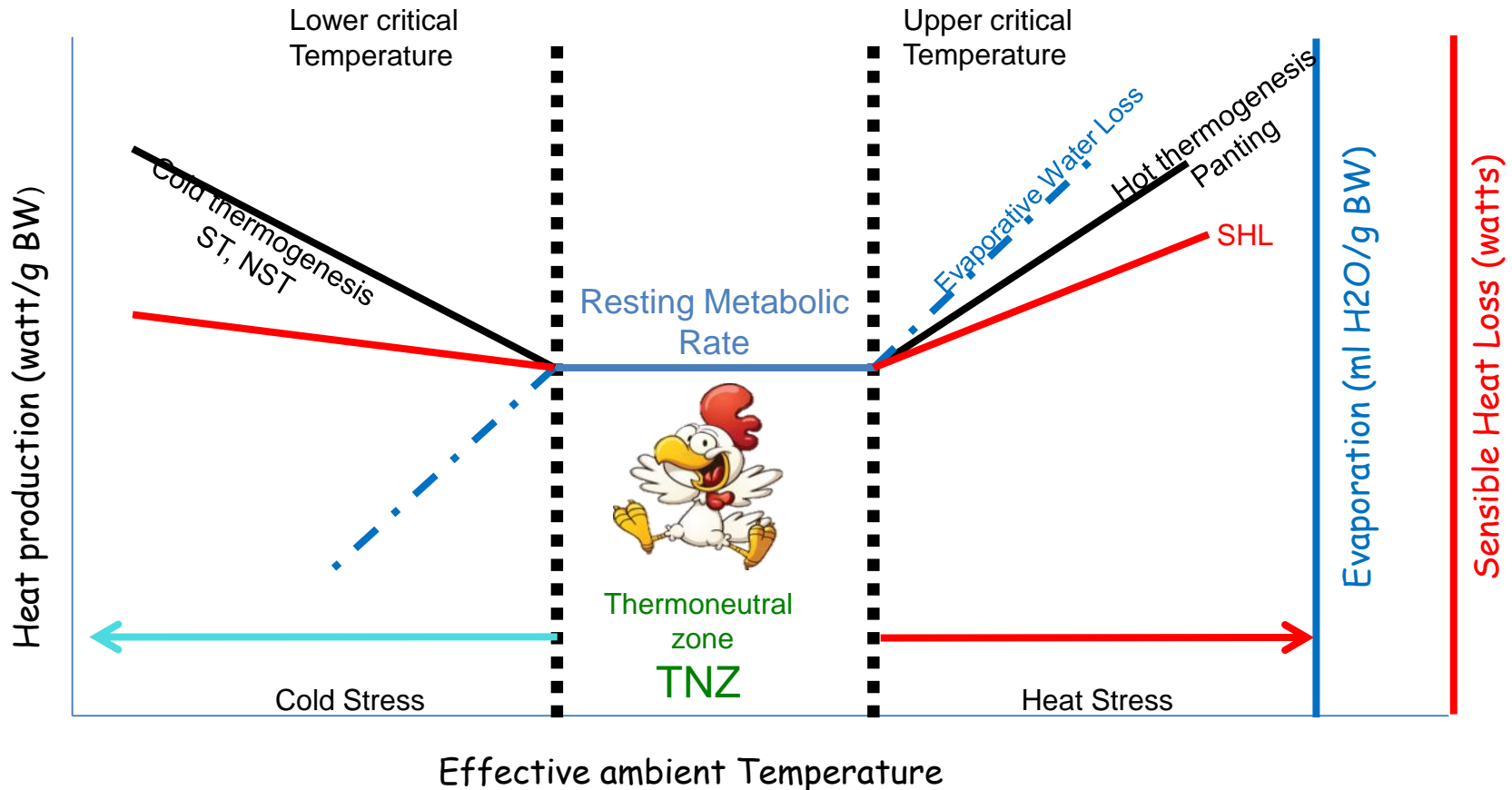
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Background

In birds, body temp. (T_b) is the most physiologically-protected parameter.

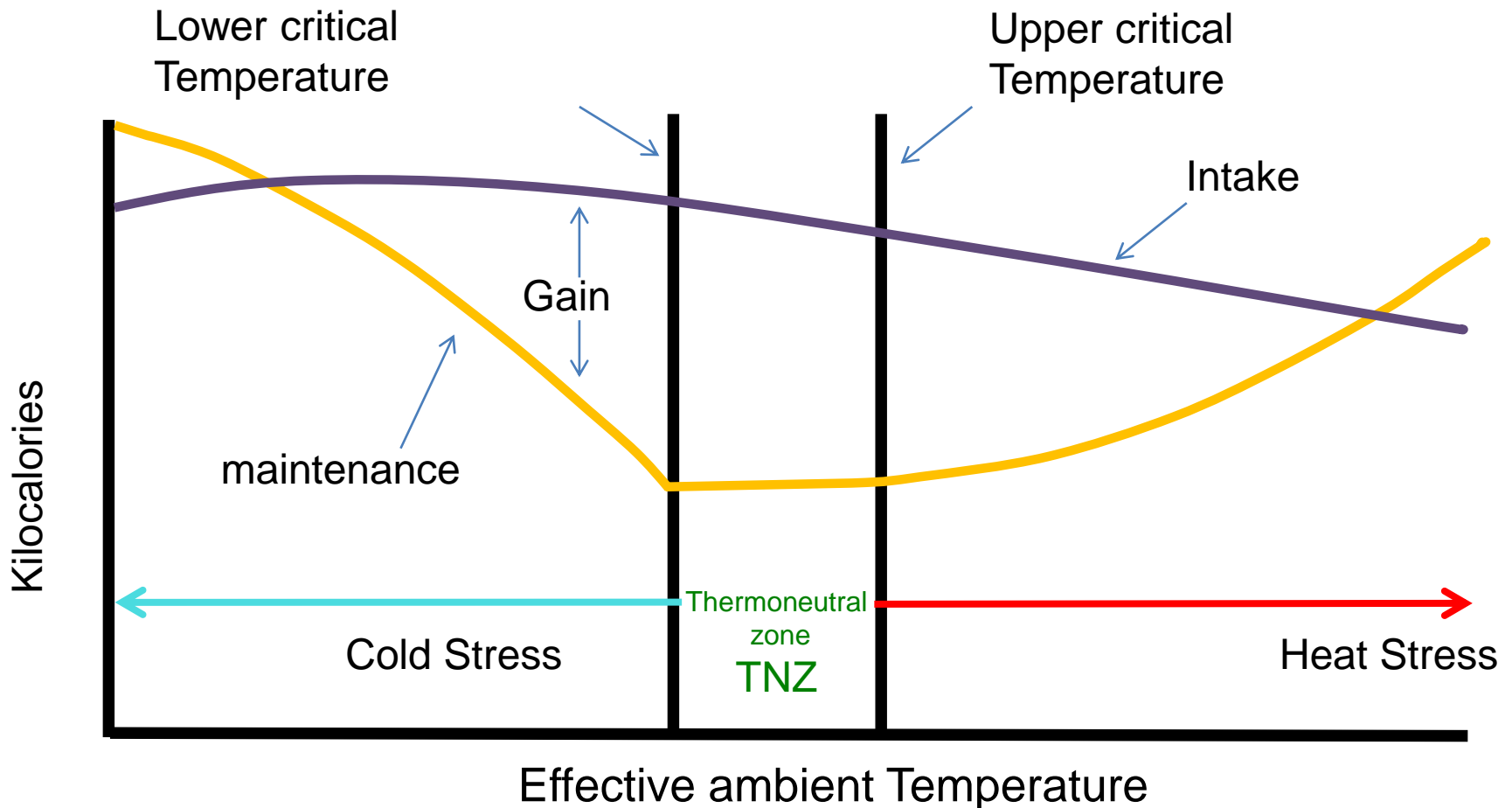
The thermoregulatory system operates at a very high gain, in order to maintain T_b within a narrow range of alteration.

$$S = M - E \pm R \pm C \pm K$$

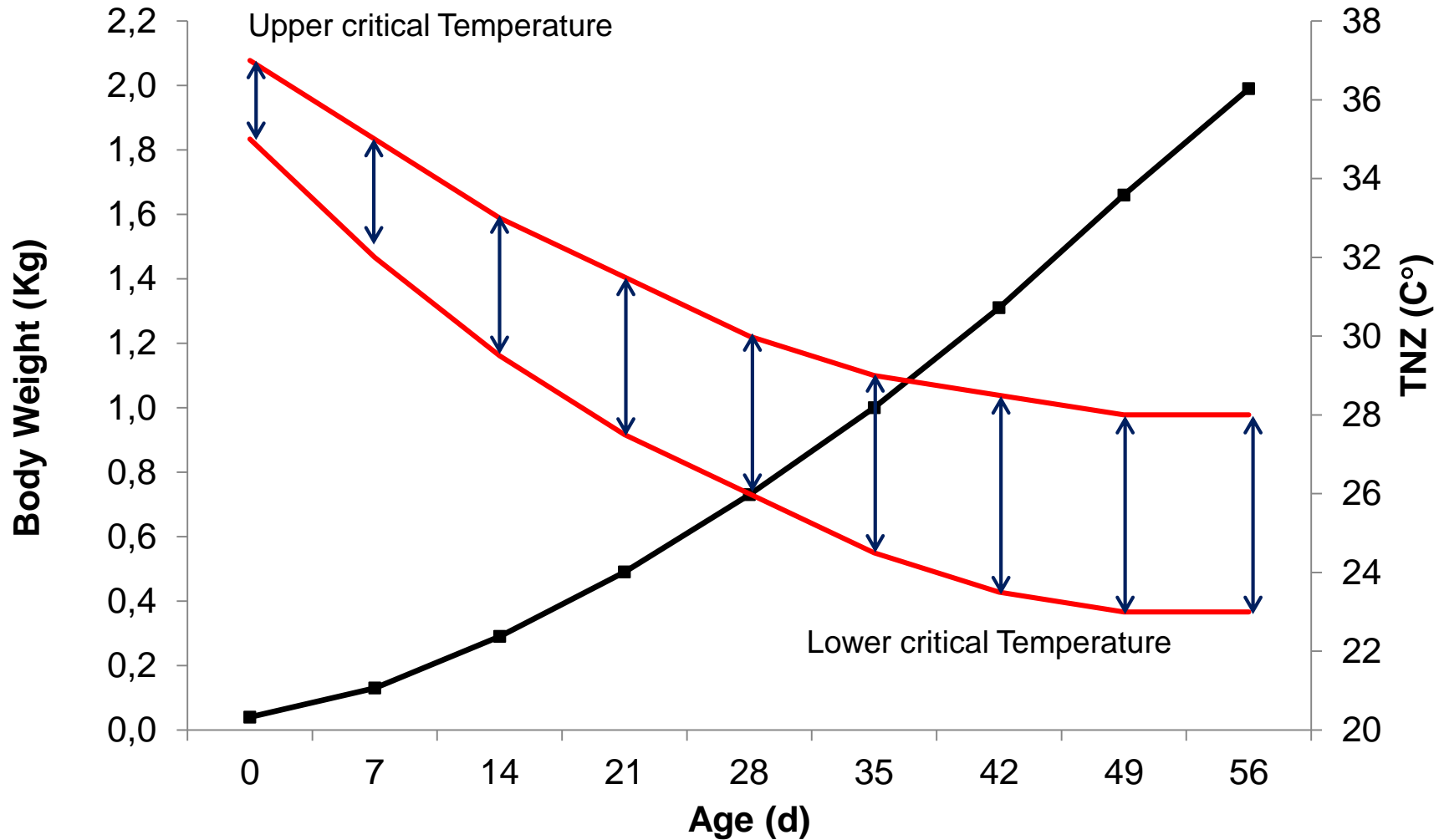


Thermo-Neutral Zone : $M = E \pm R \pm C \pm K$

In TNZ, the body is in thermal equilibrium with the environment and produce energy at the resting metabolic rate (RMR)



The lower and upper critical temperatures of broilers from hatch to 56 days, and their body weights (1980's broilers)

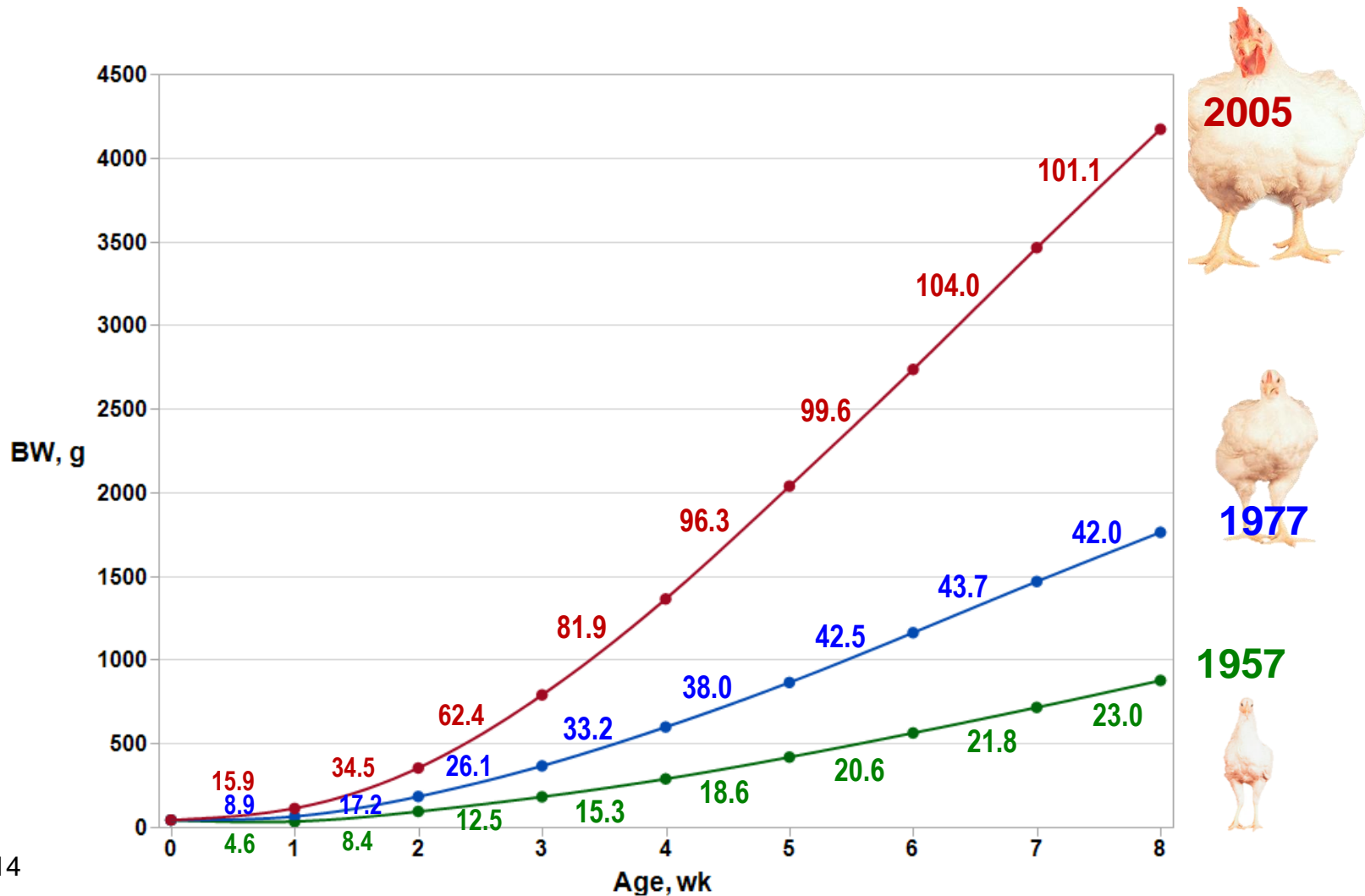


(Based on Meltzer A., 1983)

Genetic improvement in growth of broilers since 1950's

Growth curves of two strains kept without selection from 1957 and from 1977, and of Ross 308 broilers (in 2005), show weekly means of body weight (BW)

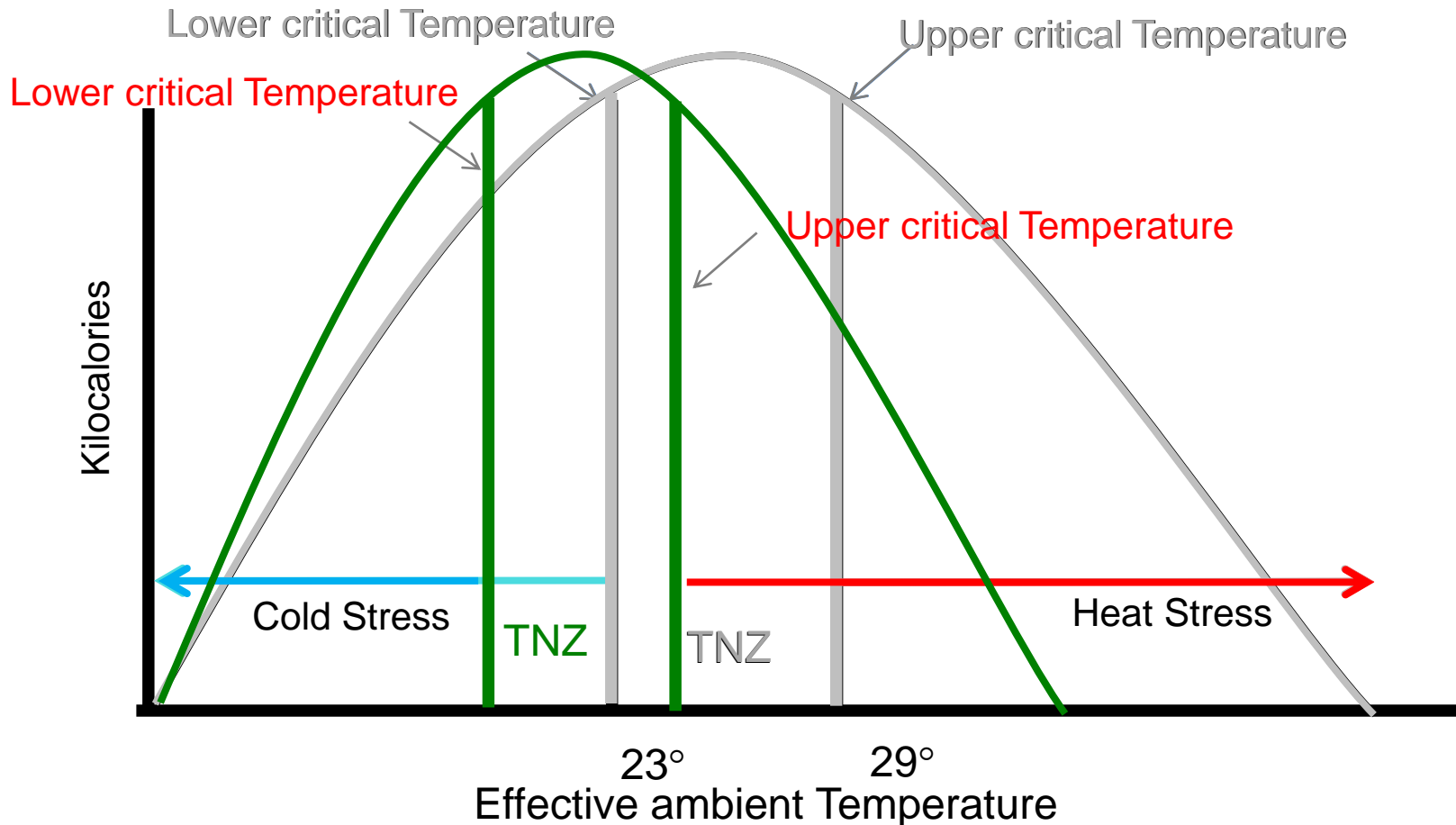
The weekly average daily BW gain (grams per day) are also shown on the graph



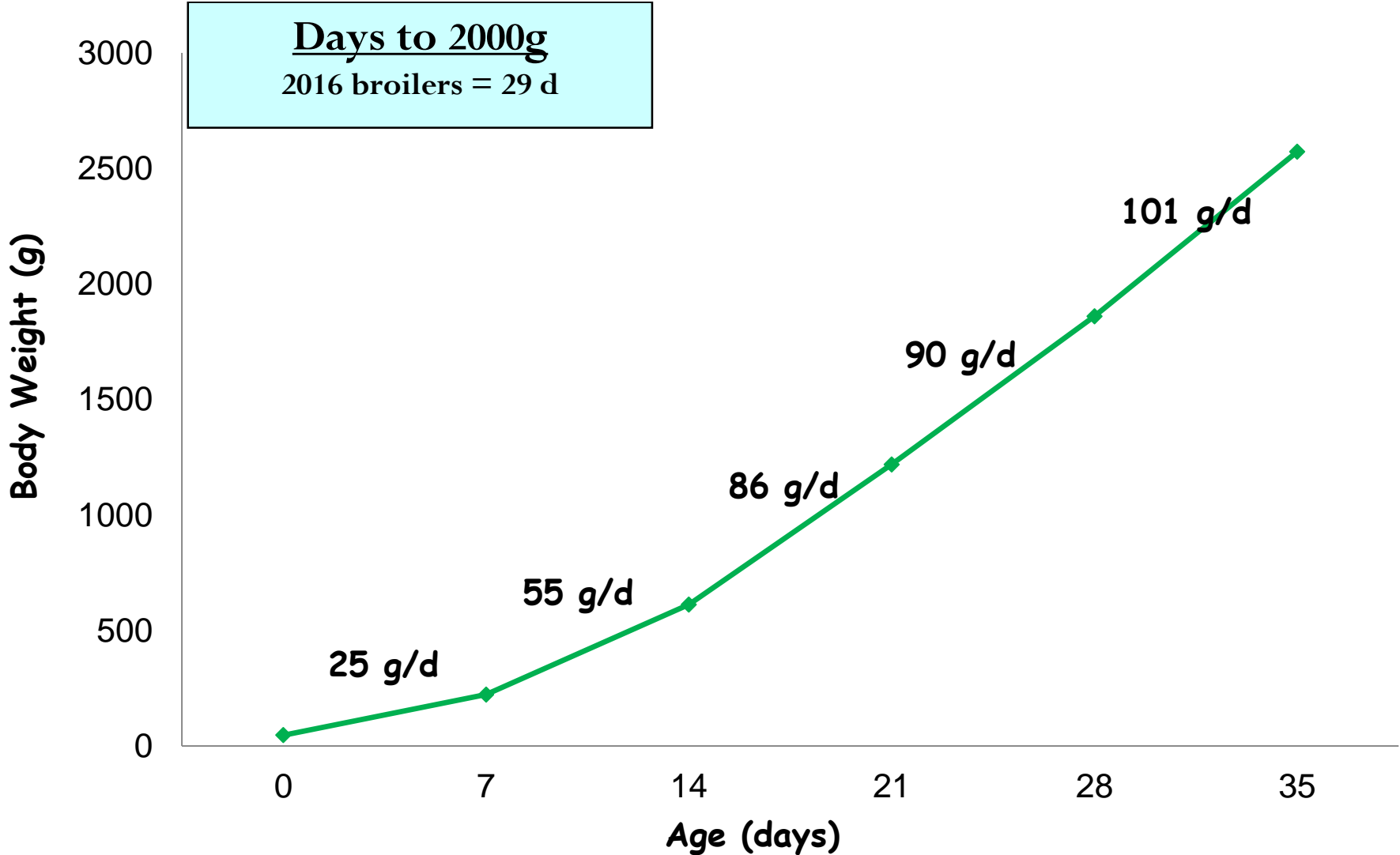
High Productivity versus Thermotolerance

Modern broilers have higher rate of feed consumption and metabolism, and consequently higher heat production

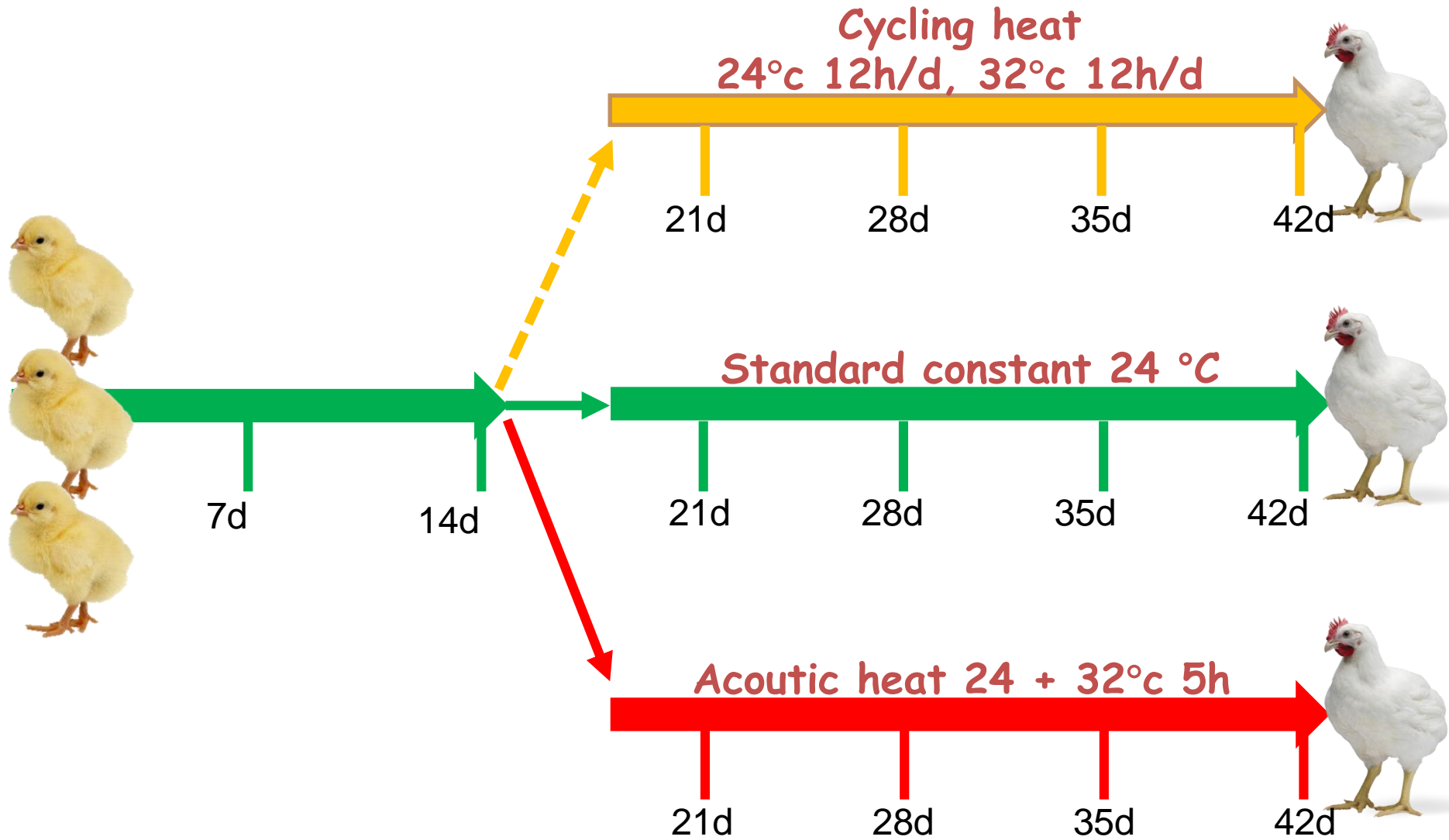
It seems that the upper and lower critical temperature limits may vary left from the ones suggested according to the genetics, age, diet, and metabolic rate of today broilers.



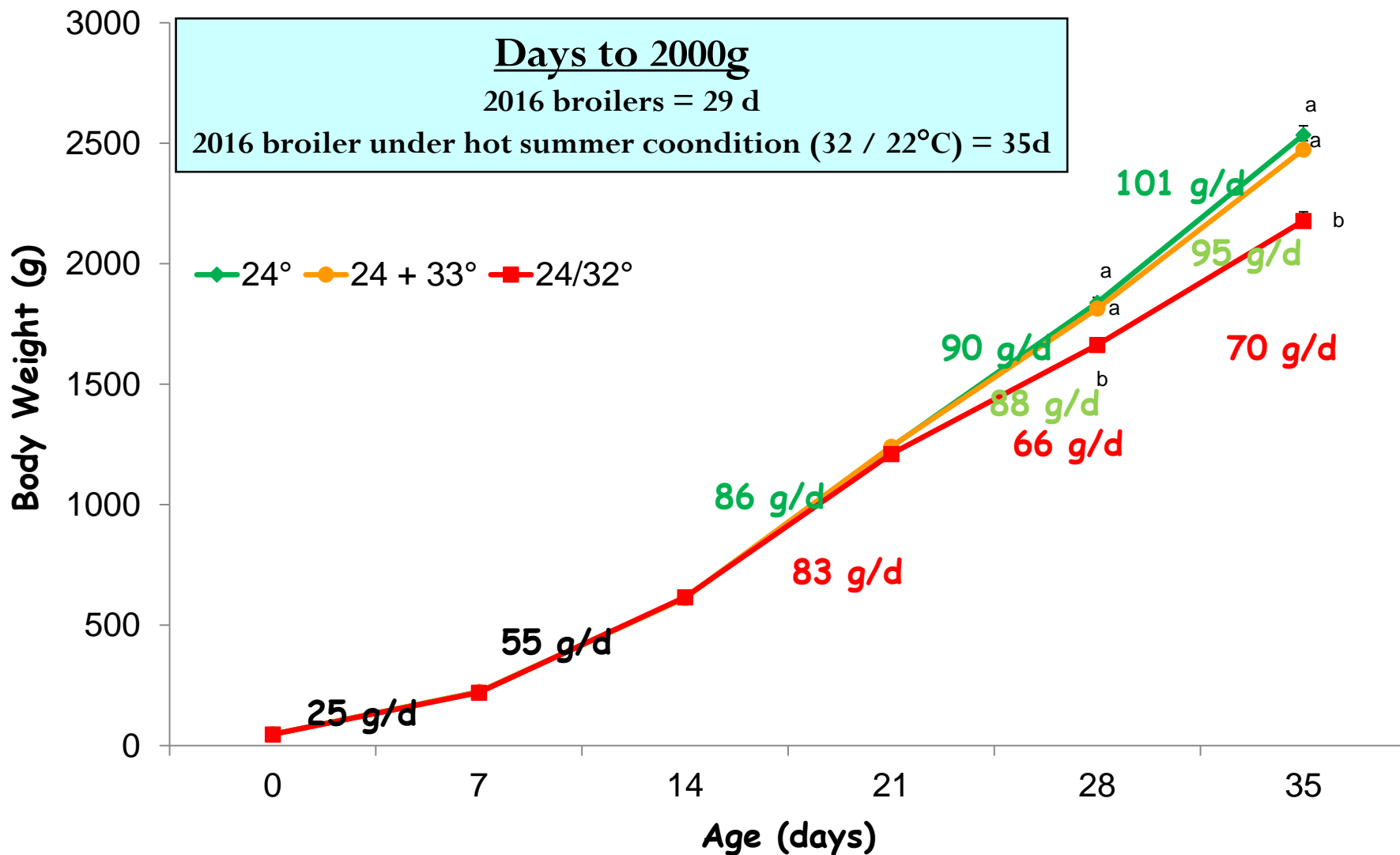
Growth rate of 2016 male broilers raised under standard conditions



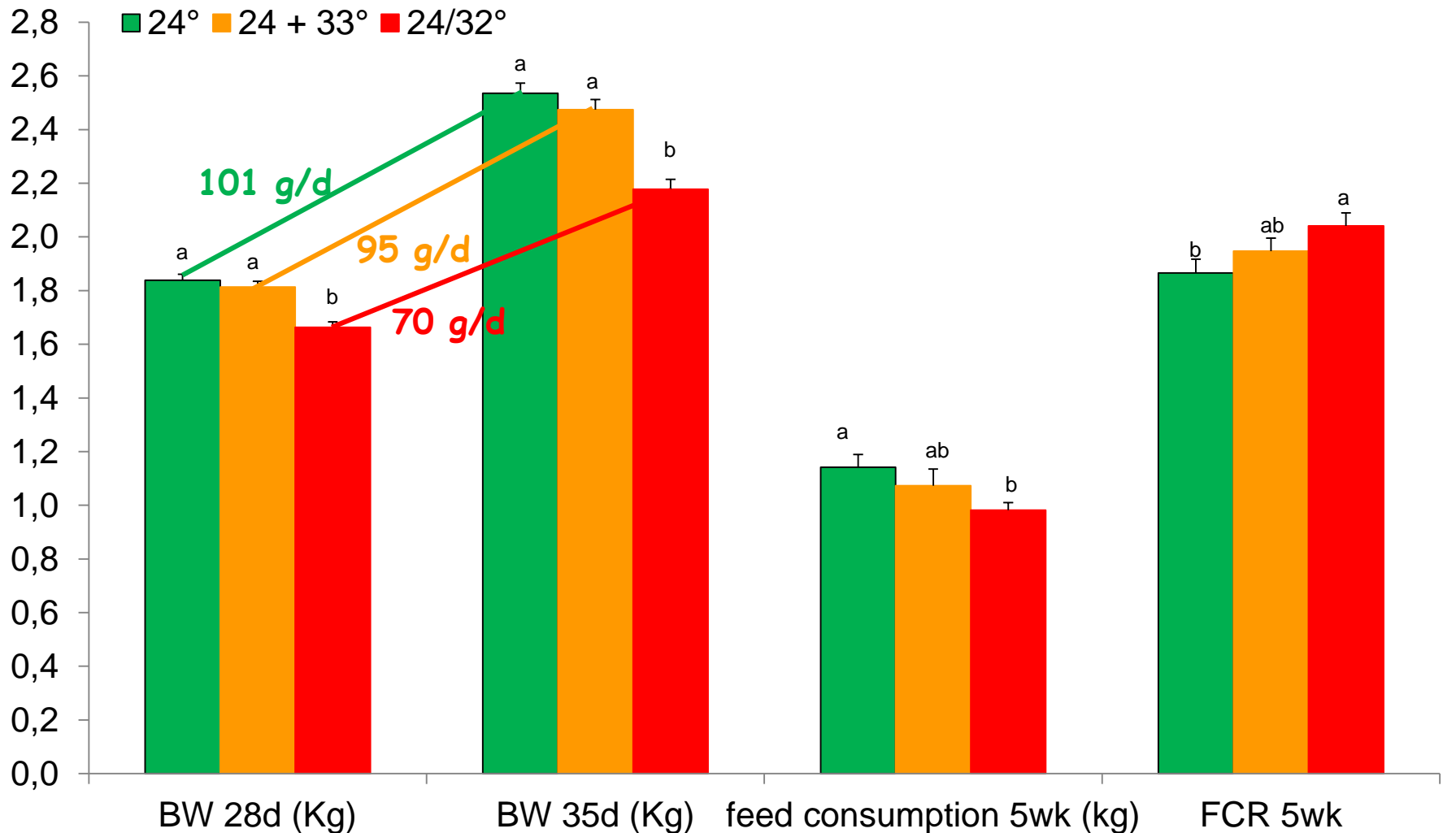
Growing Trial:



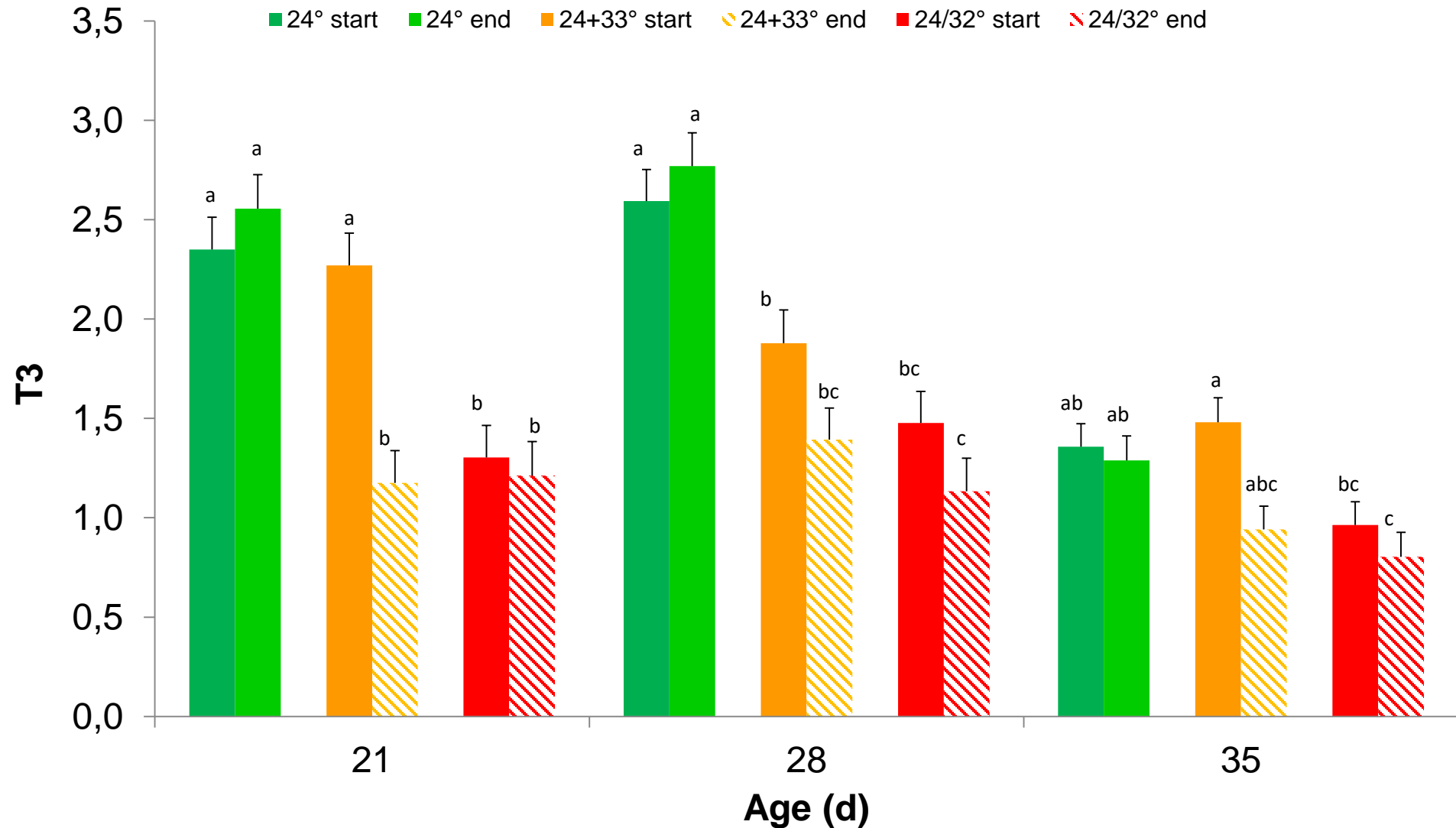
Growth rate of 2016 male broilers raised under either **standard conditions**, **short-term rapid elevation** in ambient temperature, or **Cycling heat 24°C 12h/d, 32°C 12h/d**



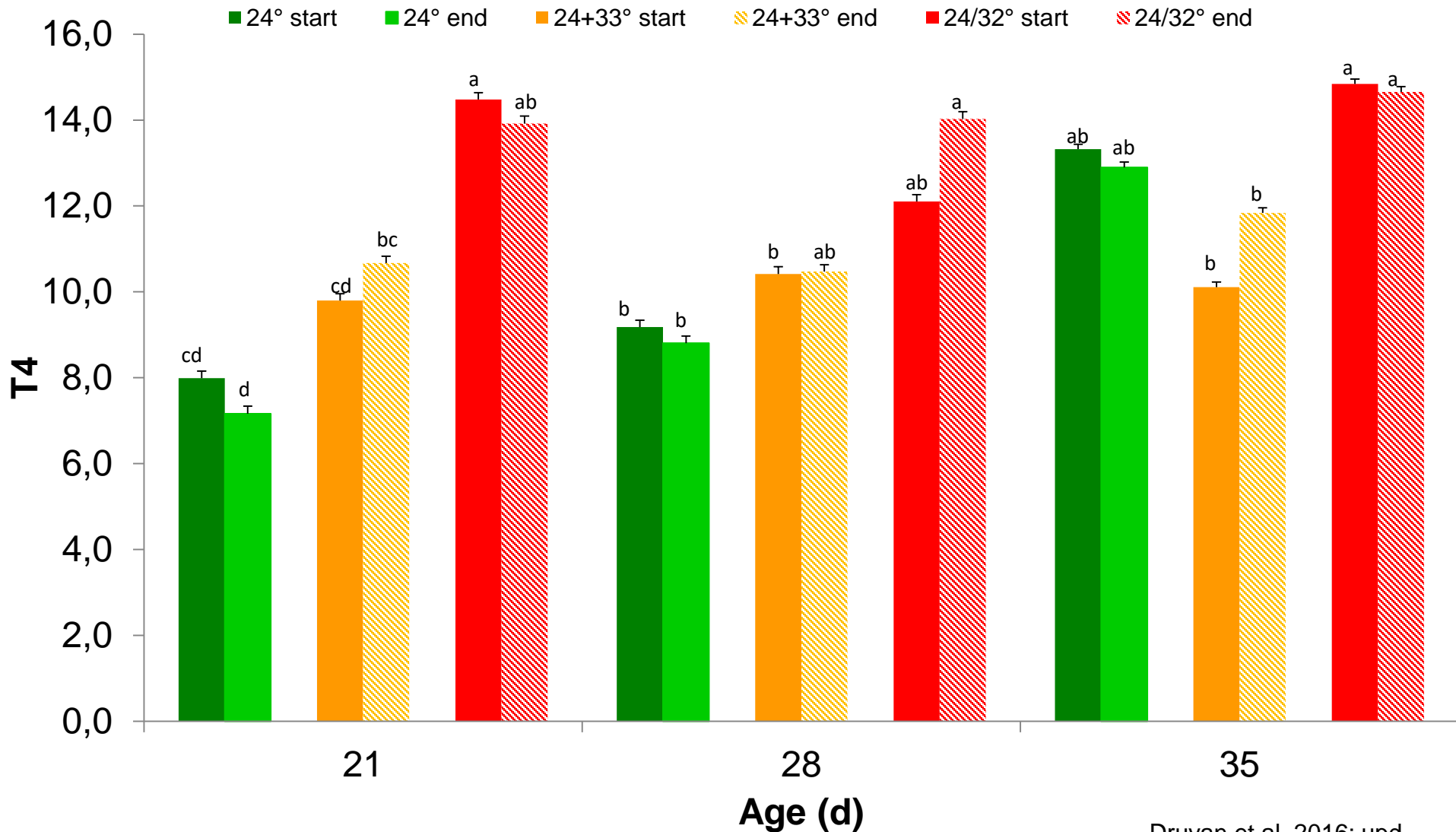
5th-week data of 2016 male broilers raised under either standard conditions, short-term rapid elevation in ambient temperature, or Cycling heat 24°C 12h/d, 32°C 12h/d



Plasma triiodothyronine (T3) concentrations of chicks kept under differing environmental temperature (before and 5h after from the beginning of heating).



Plasma thyroxin (T4) concentrations of chicks kept under differing environmental temperature (before and 5h after from the beginning of heating).





It seems that contemporary commercial broilers have difficulties in maintaining dynamic steady-state processes under extreme changes in environmental conditions.

High ambient temperatures can have a major impact on performance and welfare of commercial poultry.

When they are coupled with high humidity, the combination can become critical.

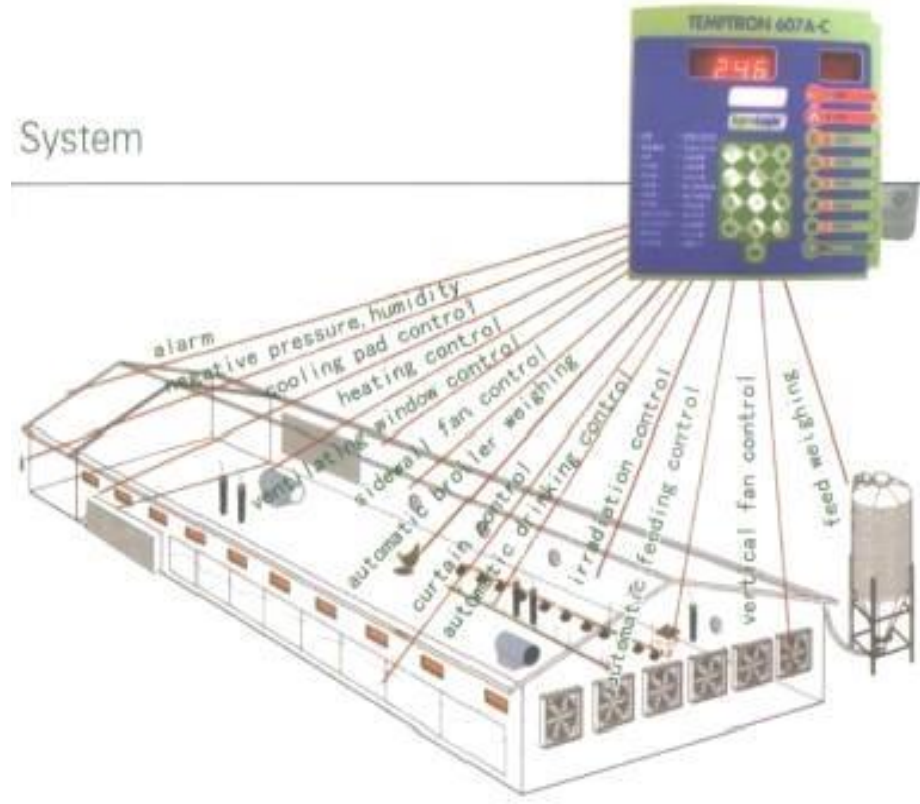
Therefore, there is a need to re-evaluate the management of poultry and equipment used, so that heat stress is minimized and animal welfare will improved.



Improving Management



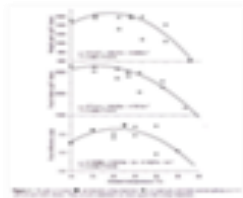
System



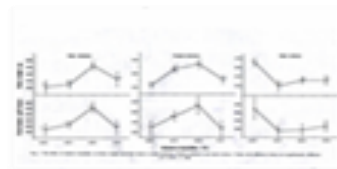
Physiology background

Optimizing the Environment

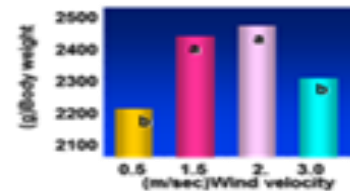
Ambient temperature



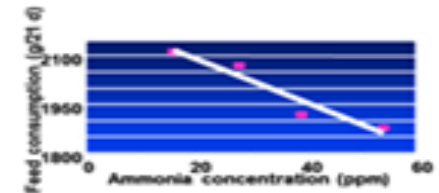
Relative humidity



Ventilation



Ammonia



Performance i.e. body weight, feed intake, feed efficiency

Optimal (22C)
versus
35C ~ 900 g

Optimal 60%
versus
40% ~ 300 g

Optimal 2 m/sec
versus
0.8 m/sec ~ 450 g

16 ppm versus
56 ppm ~ 150 g

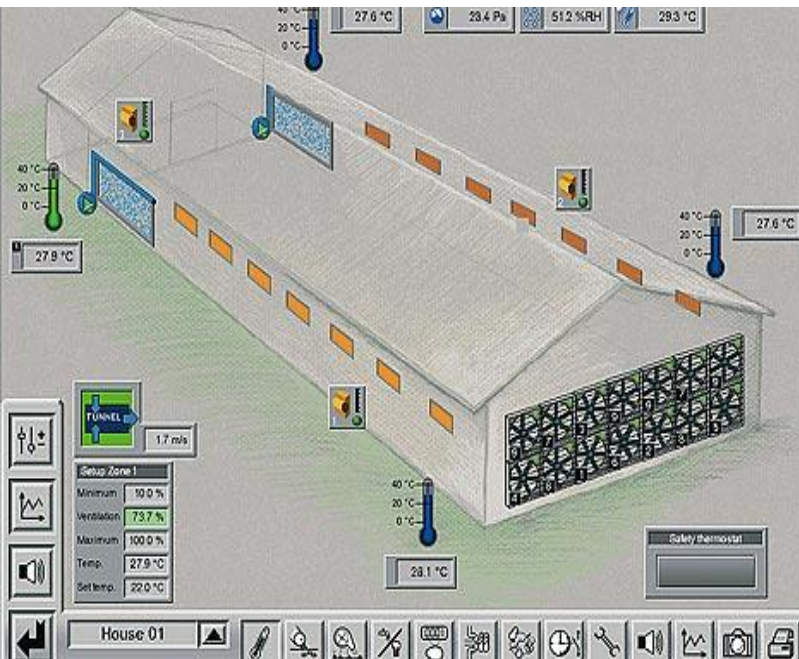
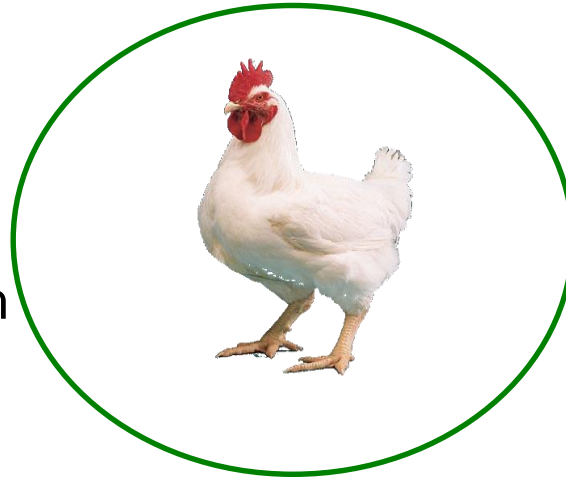
Yahav, S., Shinder, D., Ruzal, M., Gilo, M. & Piestun, Y. (2009). Controlling body temperature – the opportunities for highly productive domestic fowl, In: Body Temperature Control. Cisneros, A. B. & Goins, B. L (Eds.), pp. 65-98, Nova Science Publishers, New York

Yahav, S. and Giloh, M. (2012). Infrared thermography – applications in poultry biological research. In: Infrared Thermography. Edited by Prakash, R.V. Intech Publications. pp. 93-116.

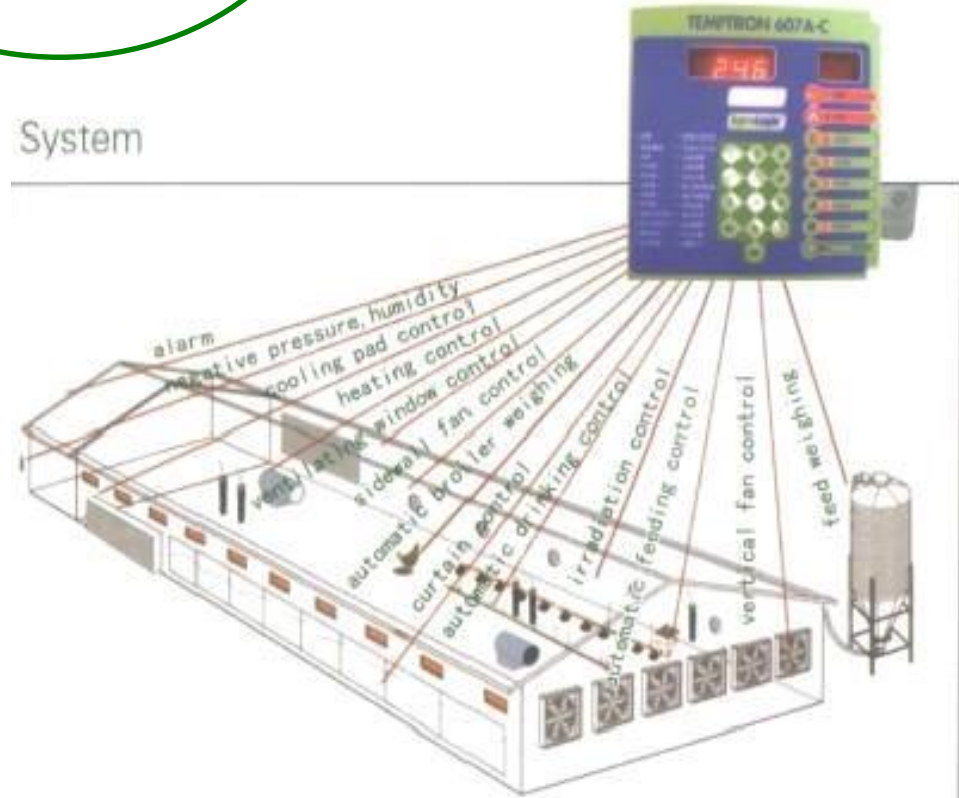
Yahav, S. (2014). Regulation of body temperature - strategies and mechanisms. In: Sturkie's Avian Physiology. VI Edition. Edited by Scanes, C. Elsevier Publications. Chapter 37, pp. 869-905.

Improving Management

Broiler centric approach

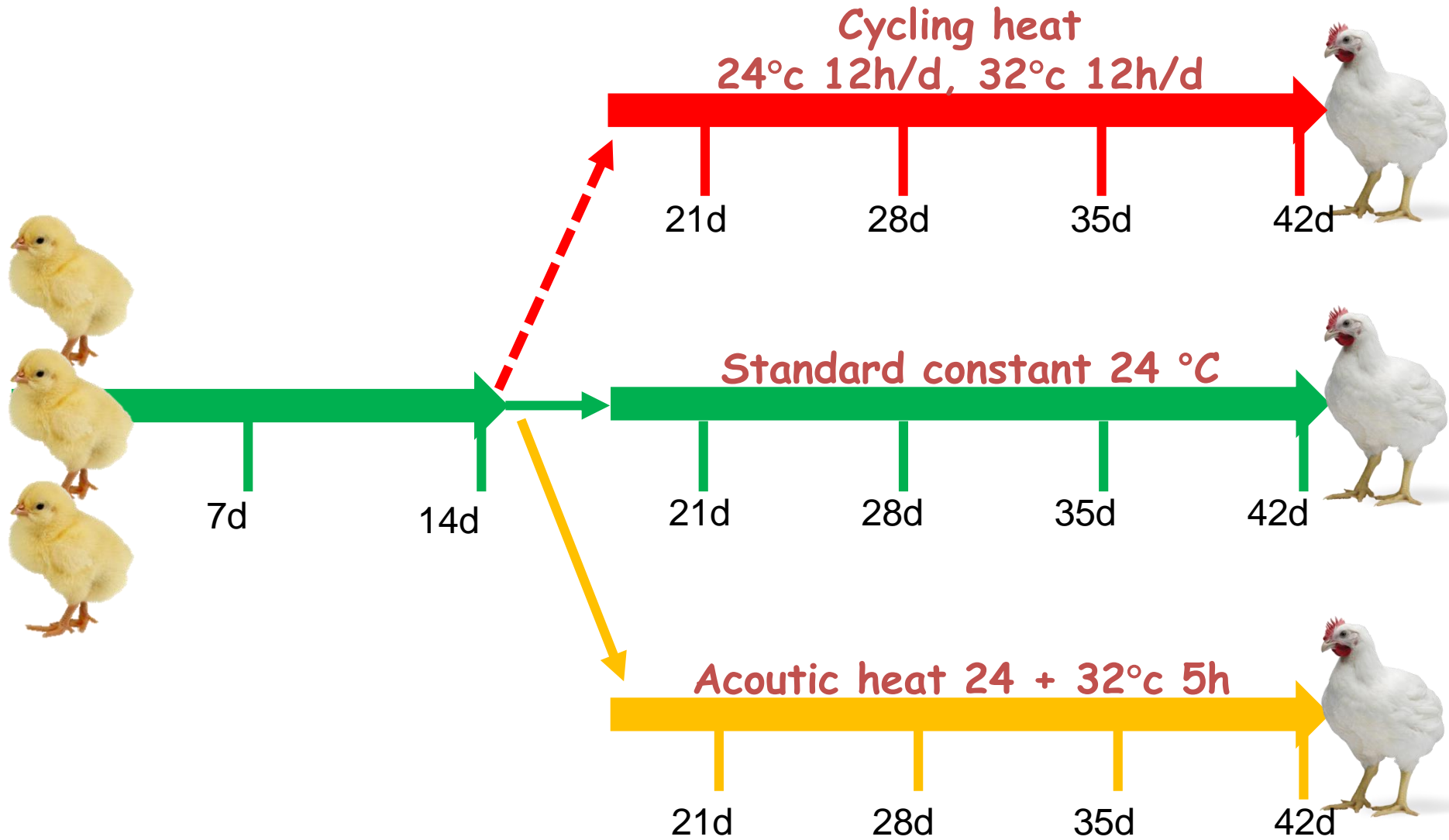


System

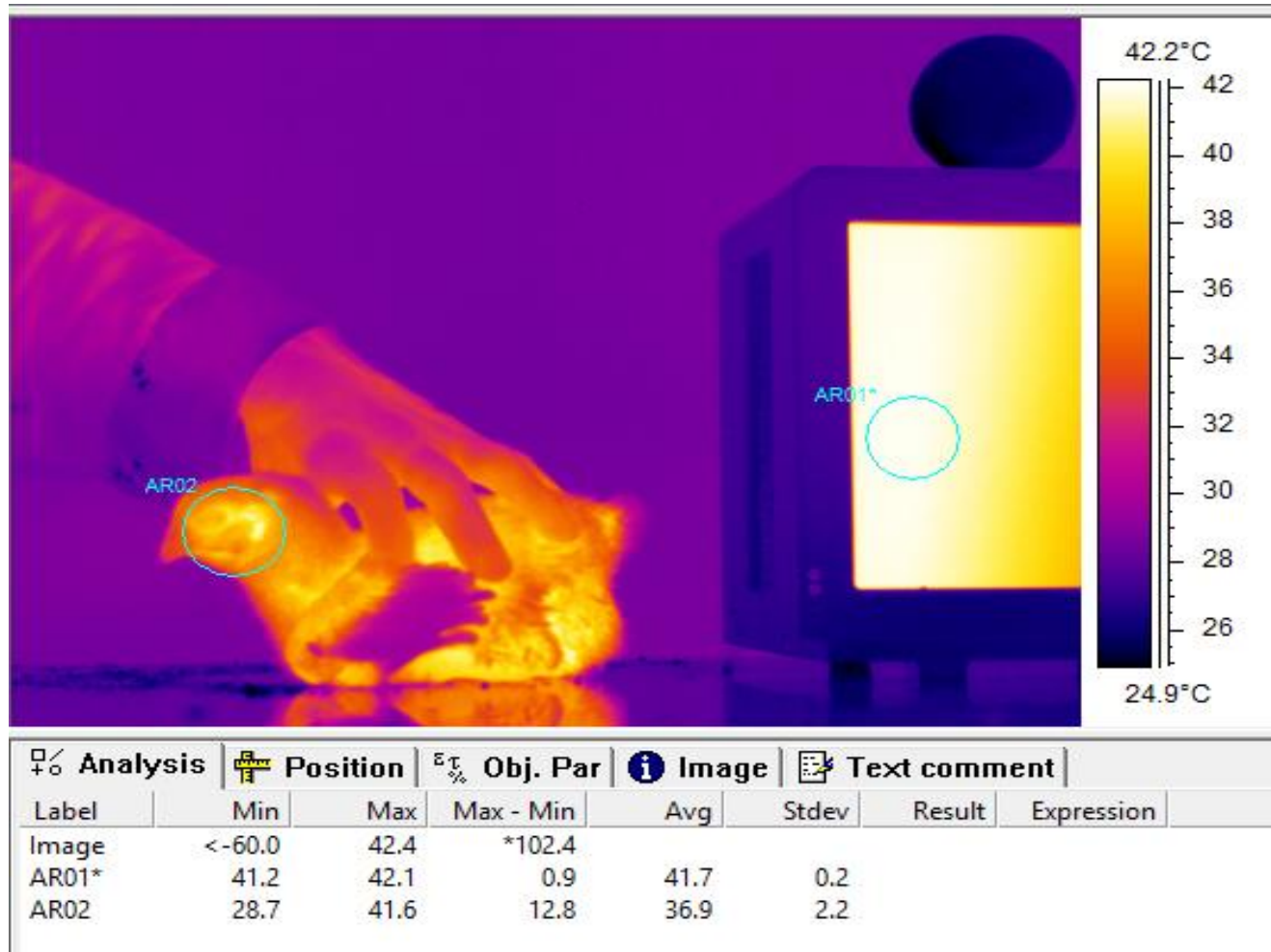




Growing Trial:

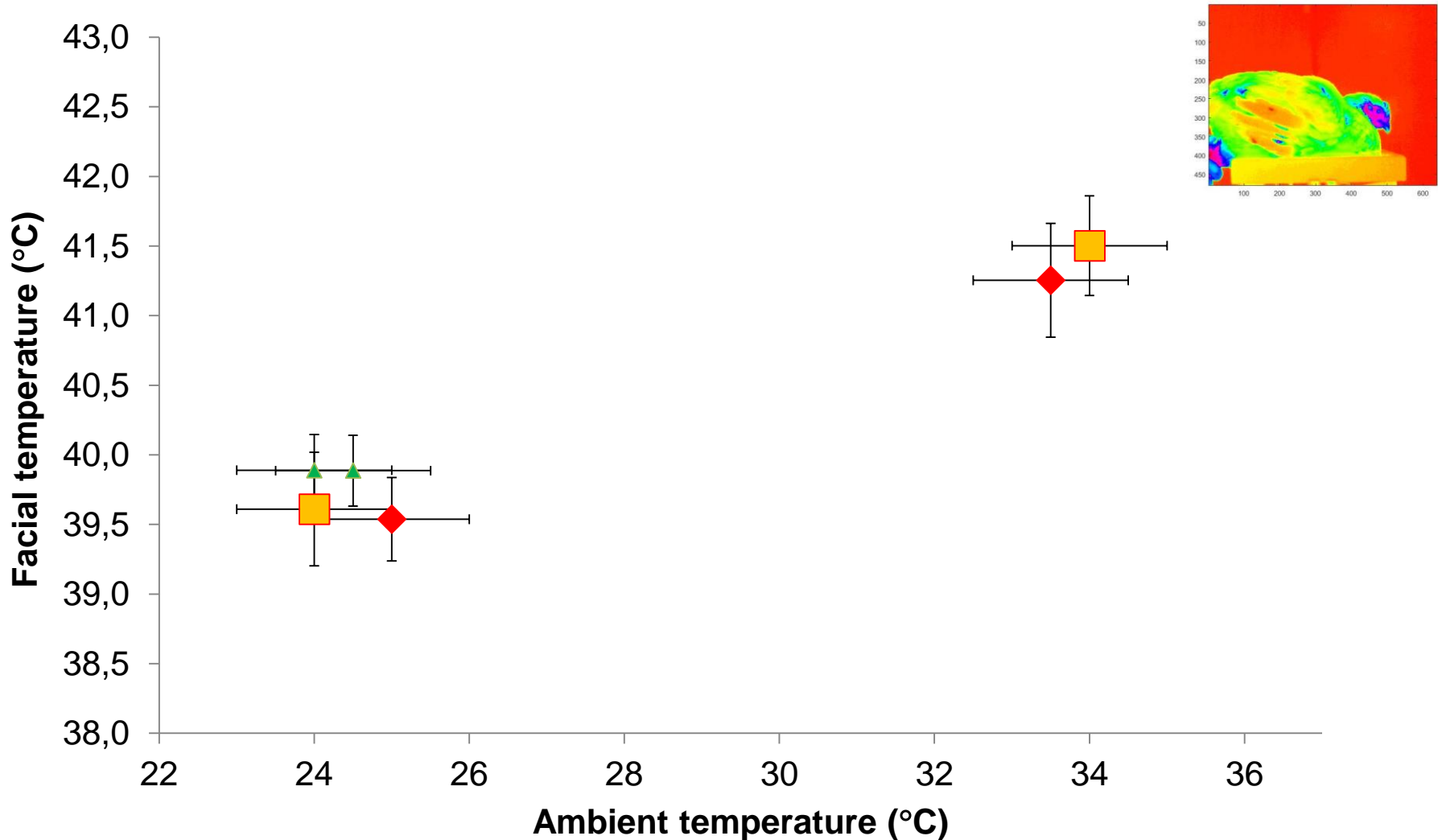


Facial temperature

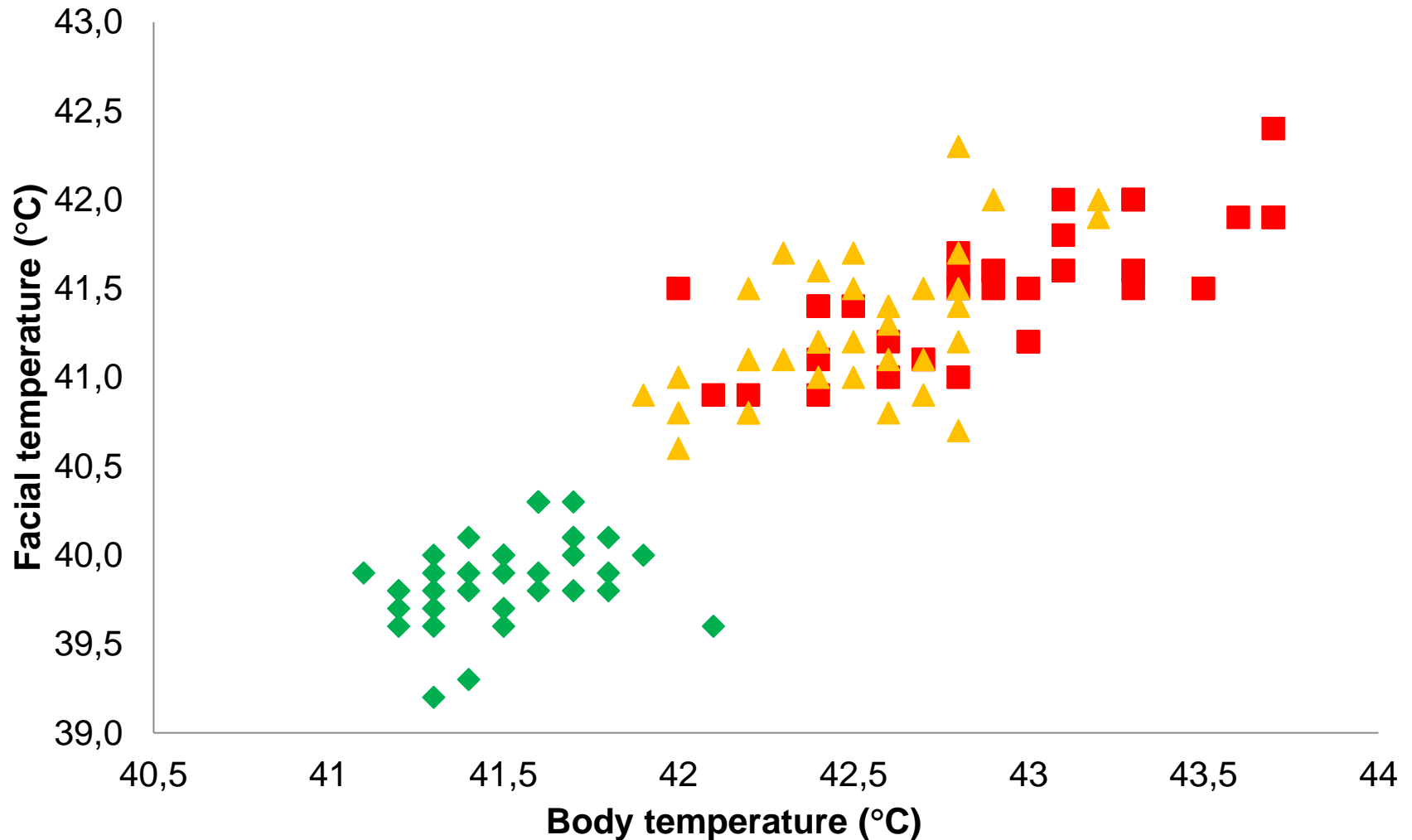


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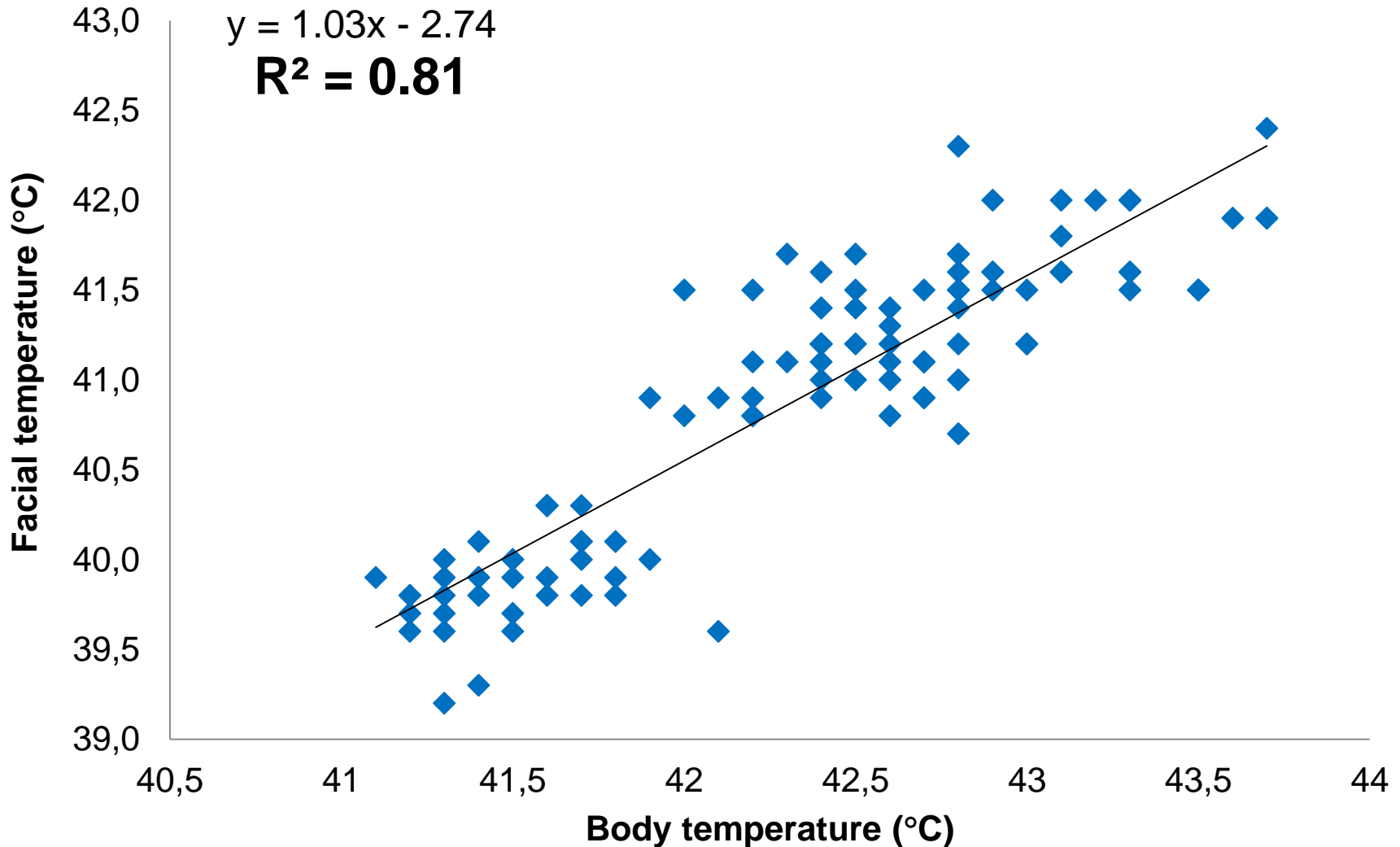
3rd-week Facial temperature of 2016 male broilers raised under either **standard** conditions, **short-term rapid elevation** in ambient temperature, or **Cycling heat 24°C 12h/d, 32°C 12h/d**



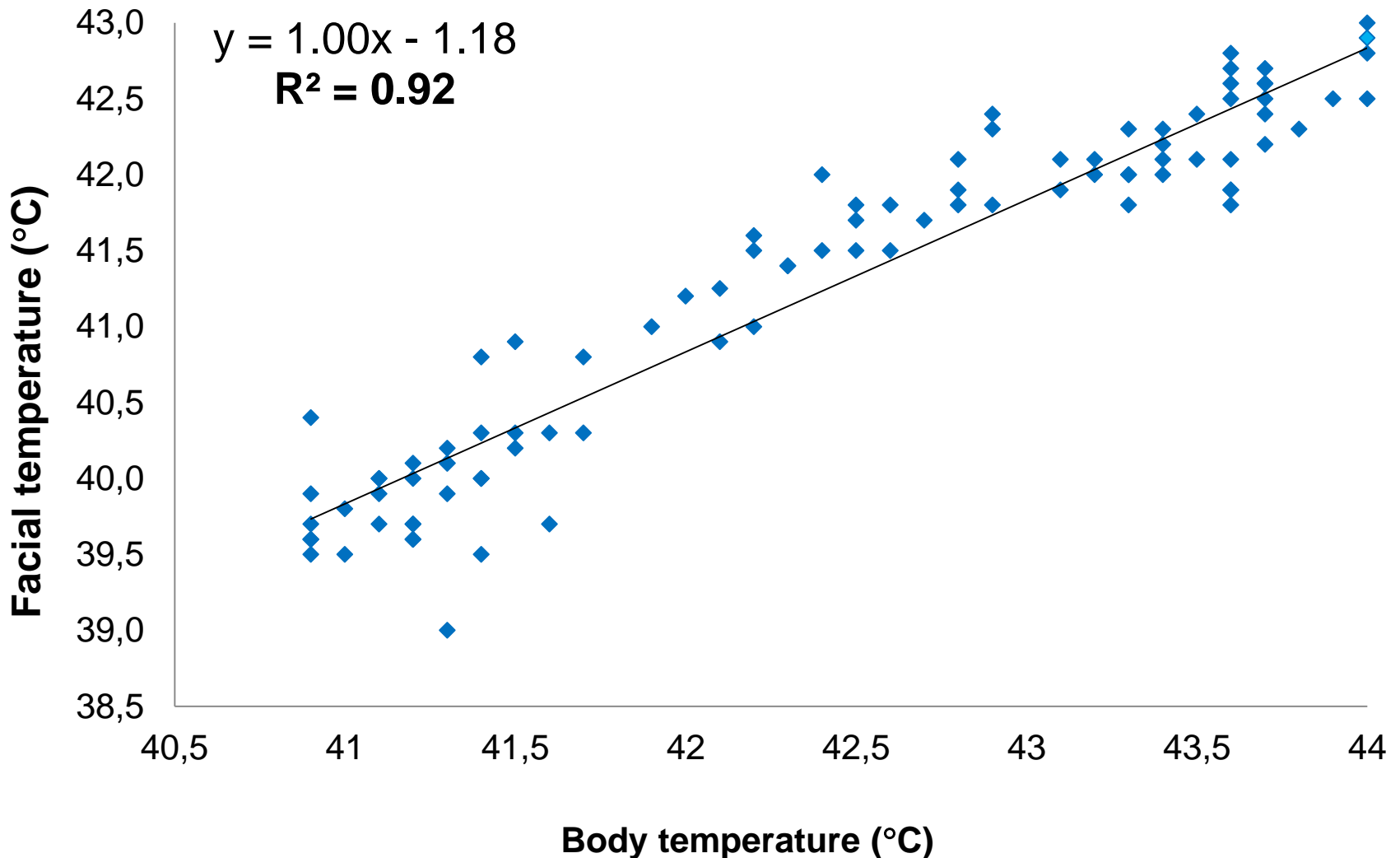
3rd-week Facial temperature of 2016 male broilers raised under either **standard** conditions, **short-term rapid elevation** in ambient temperature, or **Cycling heat 24°C 12h/d, 32°C 12h/d**



3rd-week Facial to body temperature correlation of 2016 male broilers raised under either **standard** conditions, **short-term rapid elevation** in ambient temperature, or **Cycling heat 24°C 12h/d, 32°C 12h/d**



5th-week Facial to body temperature correlation of 2016 male broilers raised under either **standard** conditions, **short-term rapid elevation** in ambient temperature, or **Cycling heat 24°C 12h/d, 32°C 12h/d**



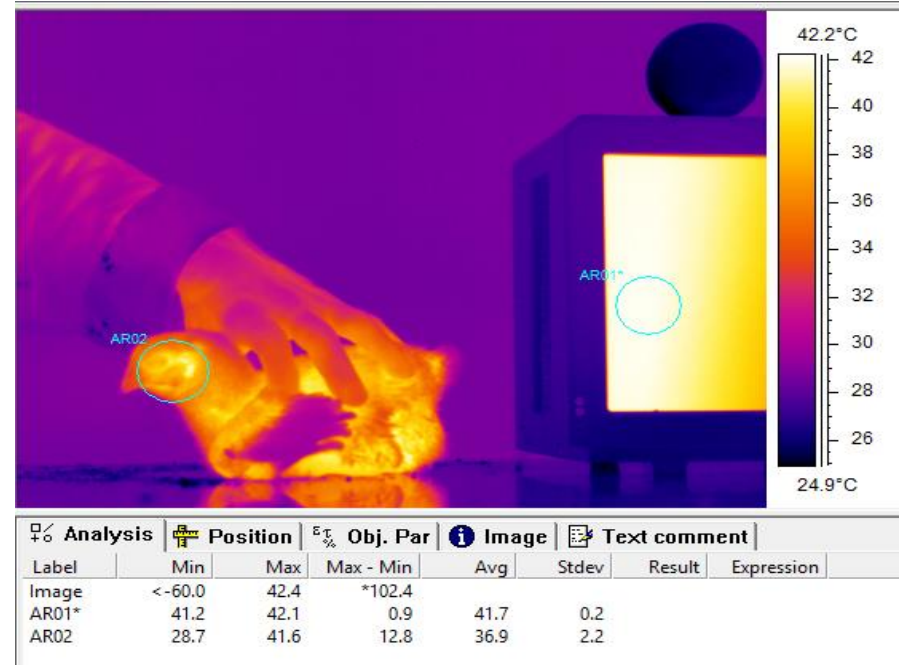
Will it work under
Commercial management condition?



Next stage no handling

Temperature logger (SL53T-A $\pm 0.1^{\circ}\text{C}$, Signatrol).

The temperature loggers were rapped with PlastyDip product that sealed the logger against water and humidity.



Chicks were implanted with RFID tag as well as Barcode identification number.



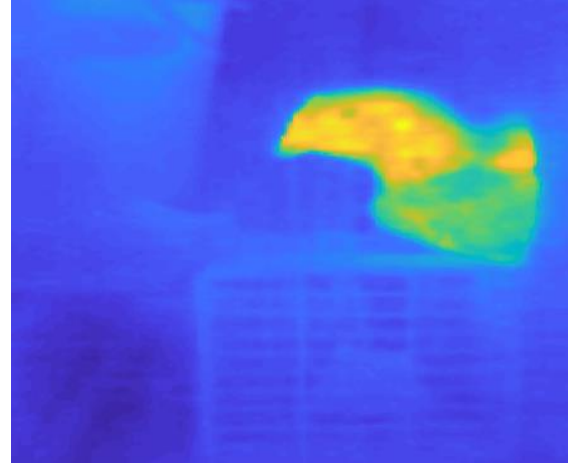
Two thermal cameras were placed perpendicular to the entry hole axis. This way, most of the time, the chicken's head was in the right orientation and distance while capturing thermal images.



Thermal image in the right orientation:



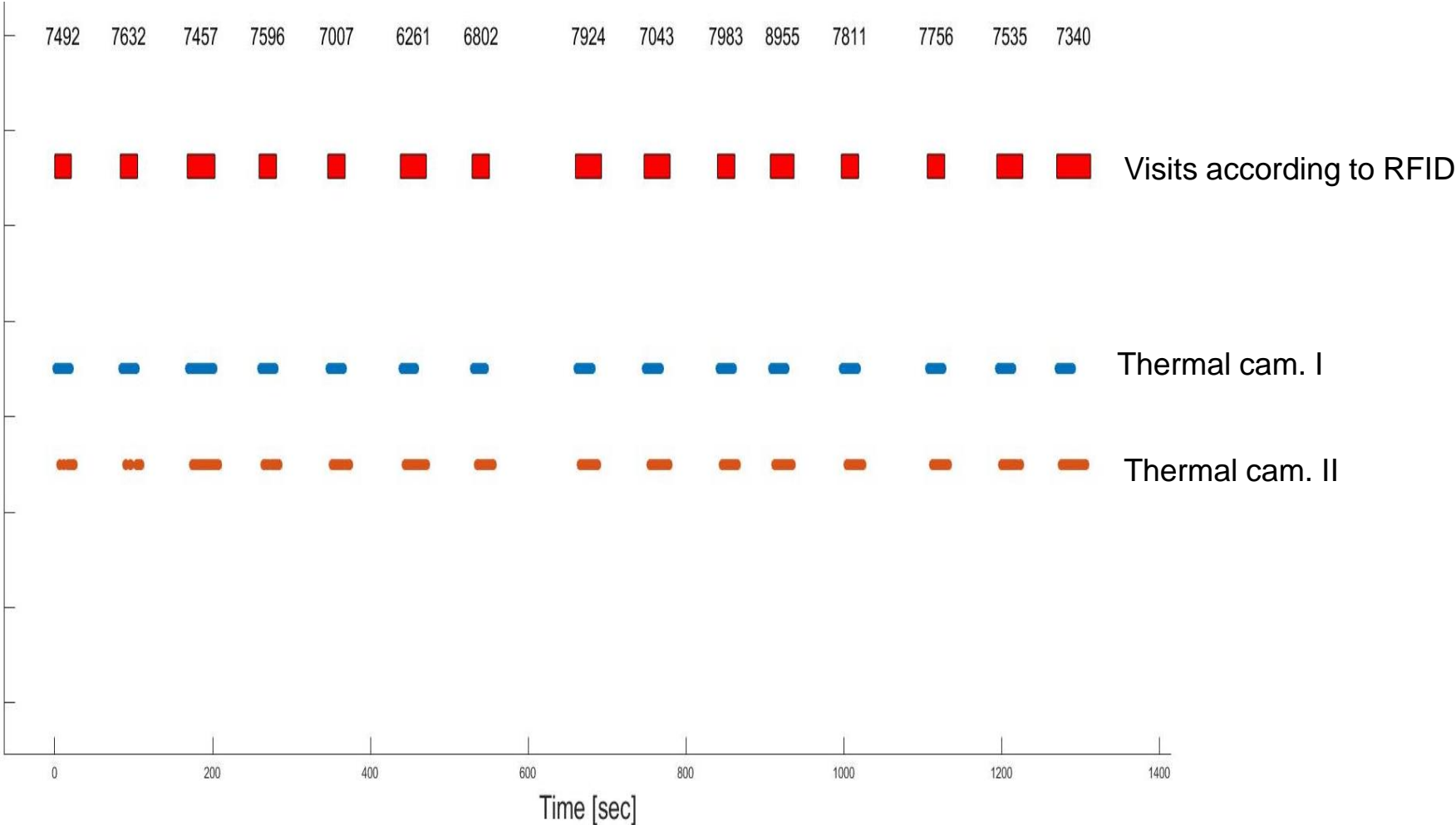
camera 1



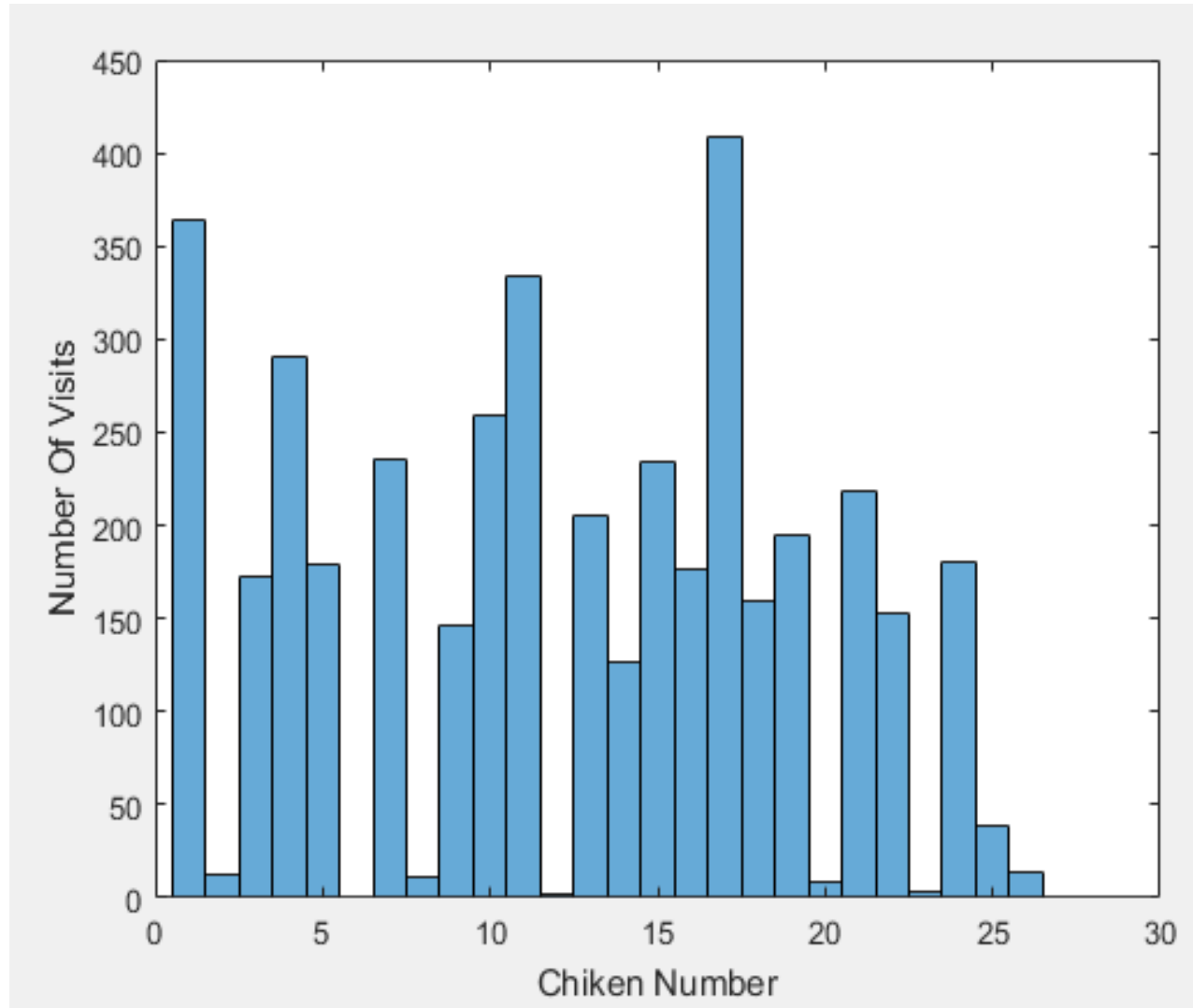
camera 2

The camera units were programmed to capture images in 2Hz for 20 second each time a bird enter its head thorough the entrance hole. The data was saved for post processing.

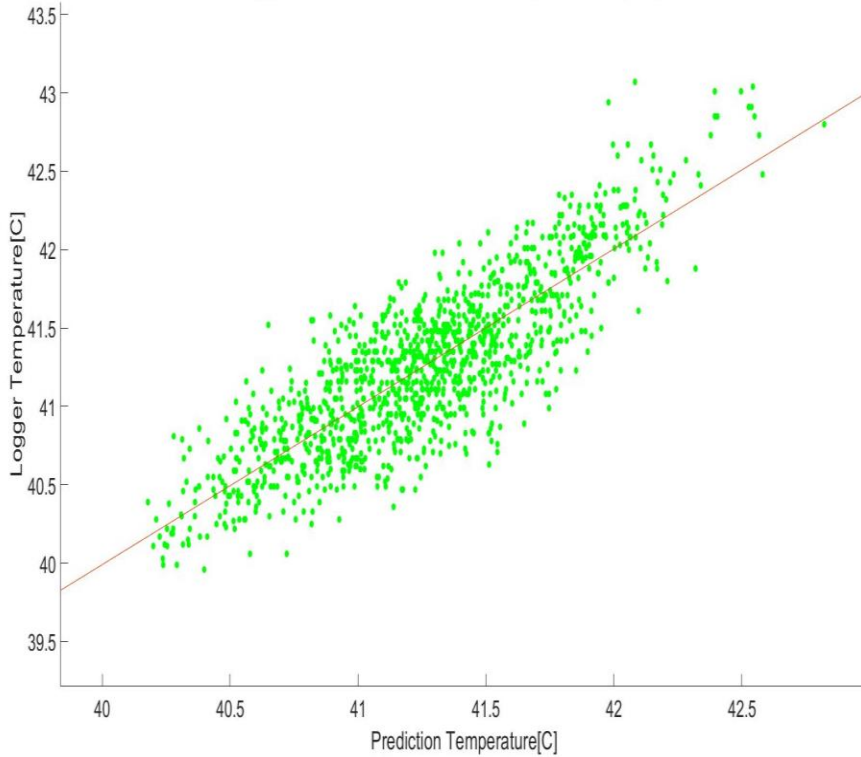
The sync between the RFID and the cameras unit was visually examined to verify the data is valid.



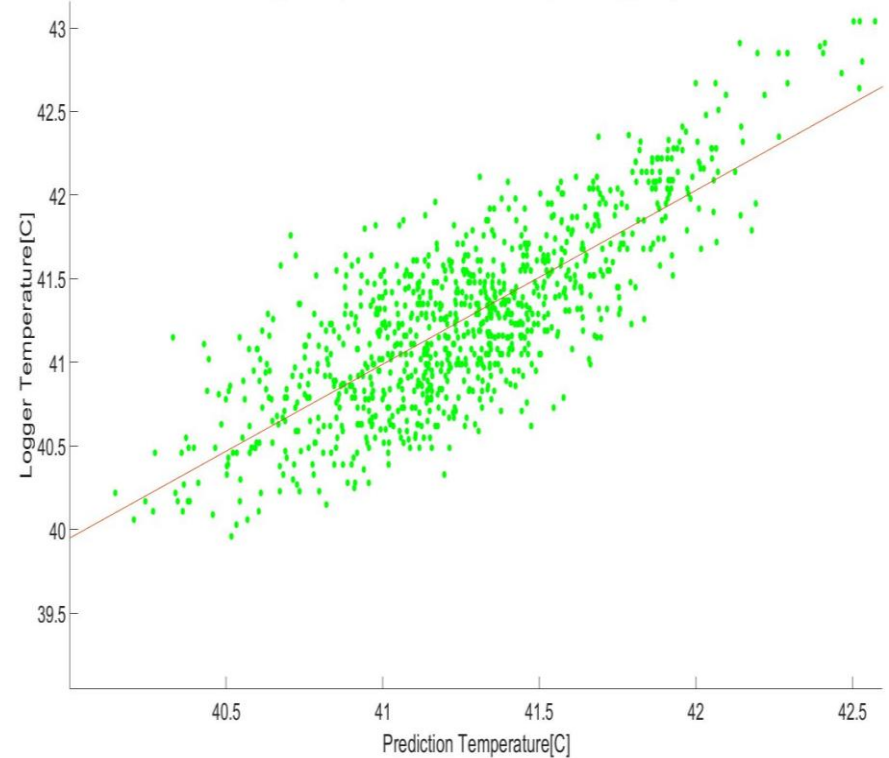
Visits distribution of chickens in the system during the whole experiment



Correlation between the prediction to the logger temperature



camera 1



camera 2

	Correlation [R^2]	Average Error [C]	STD of Average Error[C]
Camera I	0.87	0.21	0.16
Camera II	0.86	0.22	0.19

Conclusions:

Broiler body temperature is the most important parameter that can influence broiler performance, metabolic rate, FCR and energy expenditure.

In order to achieve the best results one must keep the broilers within their TNZ.

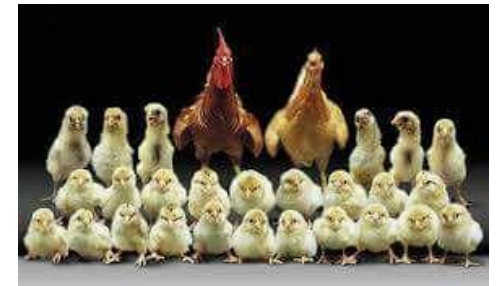
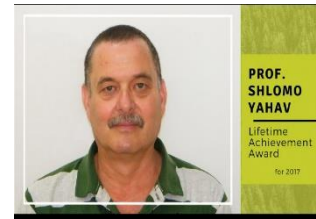
Monitoring broilers body temperature during the growing period will able us to fit the environmental condition for the broiler's physiological demands.

By developing this new sensor, broiler's body temperature can become one of the crucial parameters that control the broiler house management system

Acknowledgements



Thank
You



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Question?

