CLIMATE-SMART Agriculture 2015

Global Science Conference

March 16-18, 2015
Le Corum, Montpellier France

Variations in egg incubation temperature enable chicken acclimation through long-lasting changes in energy metabolism

Loyau T., Métayer-Coustard S., Berri C., Mignon-Grasteau S., Hennequet-Antier C., Praud C., Duclos M.J., Tesseraud S., Coustham V., Nyuiadzi D., David S.-A., Everaert N., Siegel P.B., Yalçin S., Yahav S., **Collin A.**

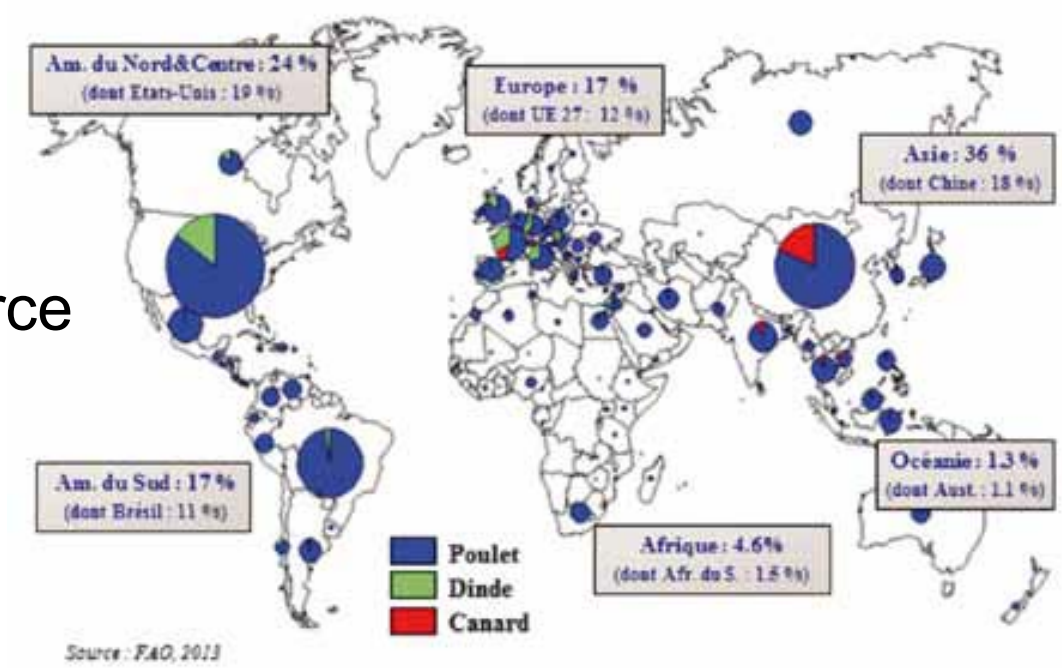
INRA Val-de-Loire, France ; ITRA Lomé, Togo; KU Leuven, Belgium; Virginia Polytechnic Institute, USA; Ege University, Turkey; ARO The Volcani Center, Israel

Montpellier

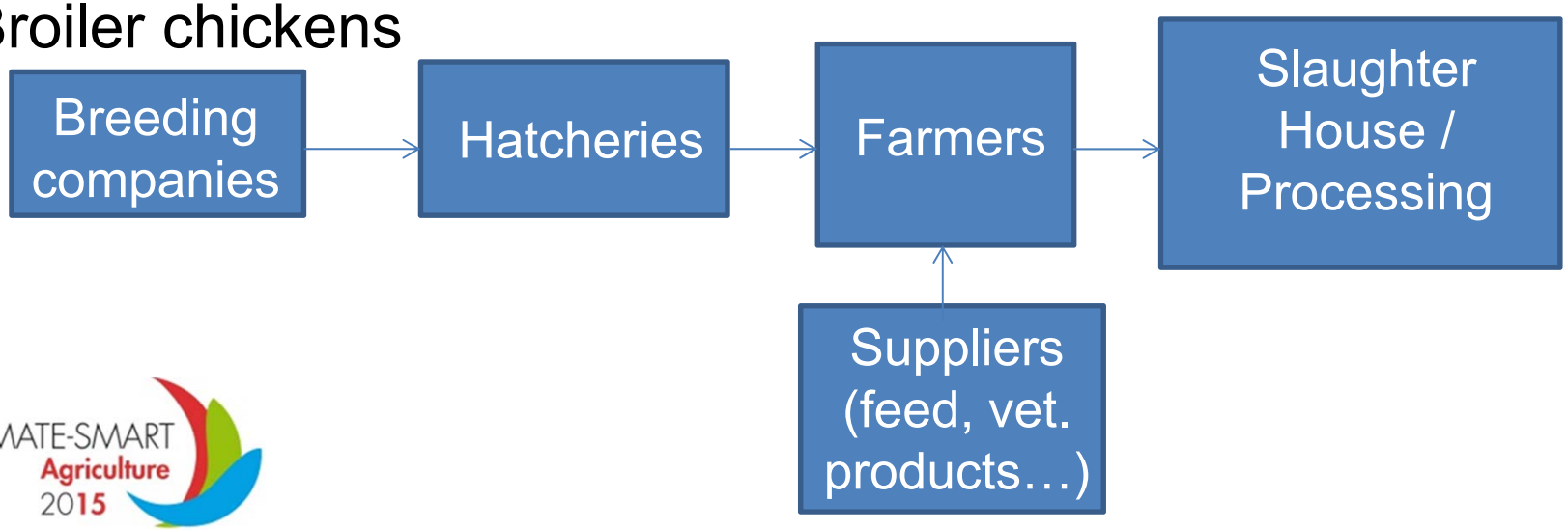
March 16-18, 2015

Context

Poultry: efficient protein source
Huge global development



Up scaling to integrated production systems
Broiler chickens



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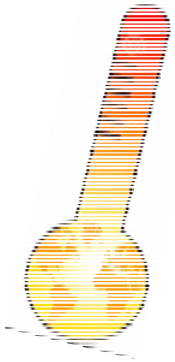
Climate change



- Avian selection in temperate conditions
- Industrial egg incubation in controlled conditions

Efficient in controlled conditions but…
Susceptibility to temperature variations

C. Nyuiadzi, **Togo**

Cressensac. La Dépêche du Midi

2003, **France**

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Strategies?

At the farmer level:

- Alerts and management strategies (feed withdrawal…)
  Control of feed quality
- Building improvements (insulation, ventilation, climatization…)

Pad cooling,
Sciences et Techniques Avicoles, 2004

http://www.boissinot-elevage.fr

BUT cost, sustainability…?

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Strategies?

To improve farm animal robustness and adaptive capacities

ReColAd network, *INRA ACCAF, Poster #151 session L2.4*

- Search for **markers of thermotolerance or desease resistance/tolerance**, **selection strategies**

ex: use of major genes controlling feathering

crossbreeding

- Conception of **innovative** **and** **sustainable rearing practices** and **production systems**

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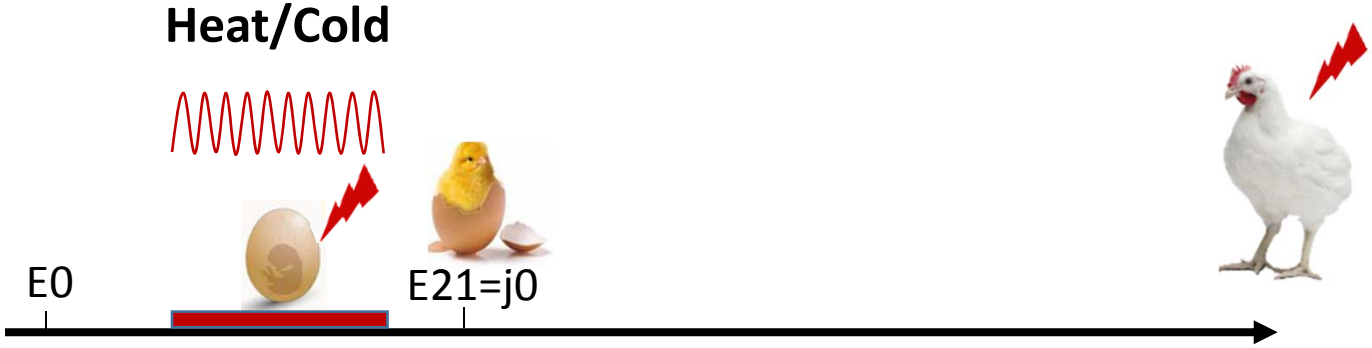
Strategies to improve poultry robustness

To reconcile thermotolerance and growth performance:

embryo acclimation

Thermal manipulation during embryogenesis (TM) Heat/Cold

Better tolerance to extreme thermal exposure



Incubator : easy treatment on a large number of eggs

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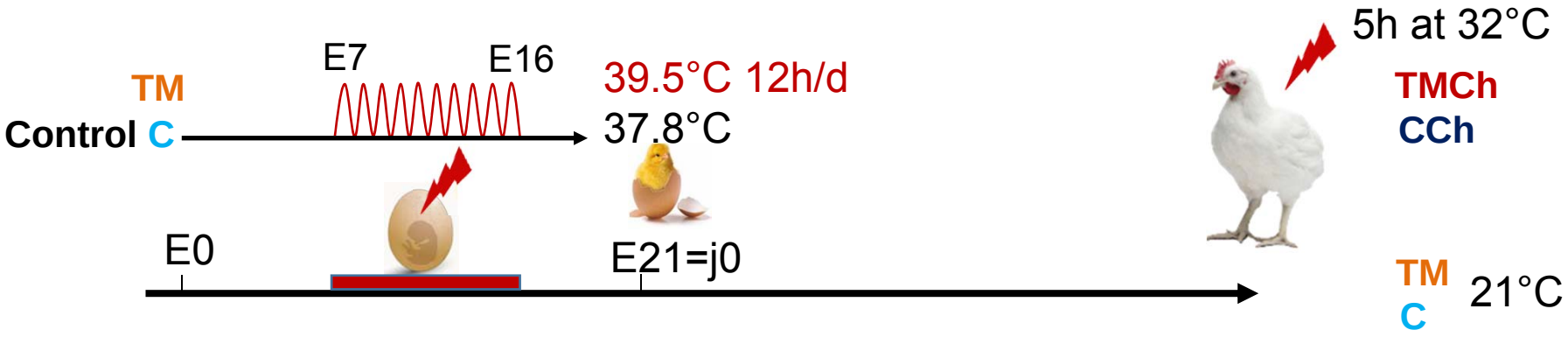
Embryo heat acclimation

Heat manipulation during embryogenesis (TM)

Heat challenge (Ch) or not at 34d



Piestun et al., Poult. Sci., 2008

- Lower body temperature from hatching to slaughter age
- 50% lower mortality in males submitted to 35 C during 5h at slaughter age

What are the physiological and metabolic mechanisms involved in the acquisition of embryo acclimation?

ANR THERMOCHICK project

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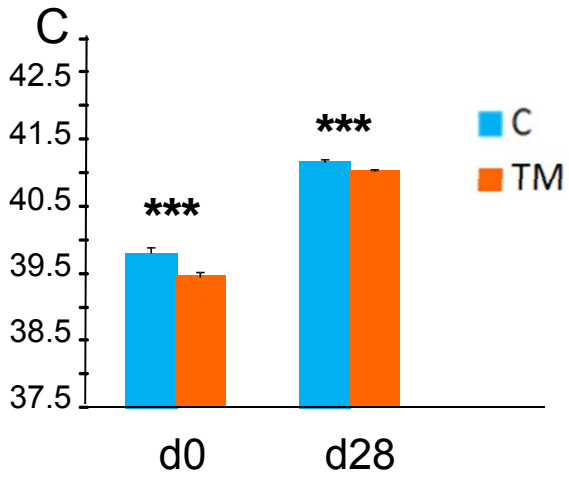
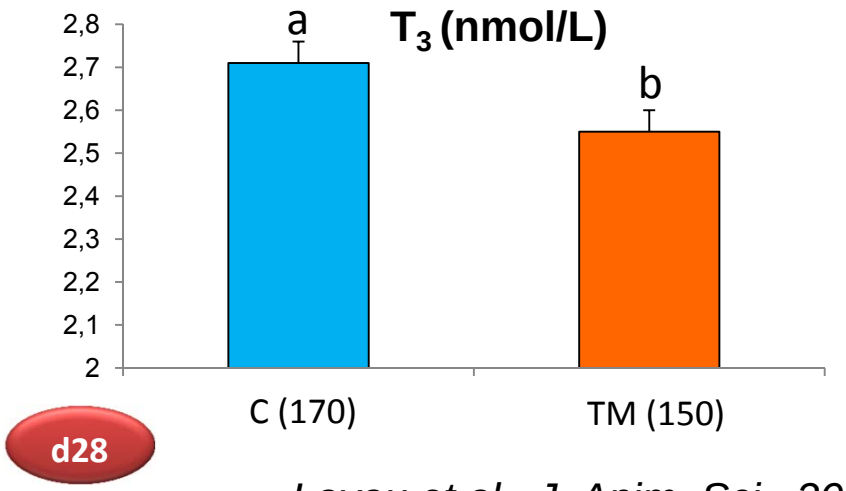
Performance and physiological parameters

<u>Performance:</u> No modification in hatchability, slightly lighter but leaner chickens
No alteration in meat processing quality by TM

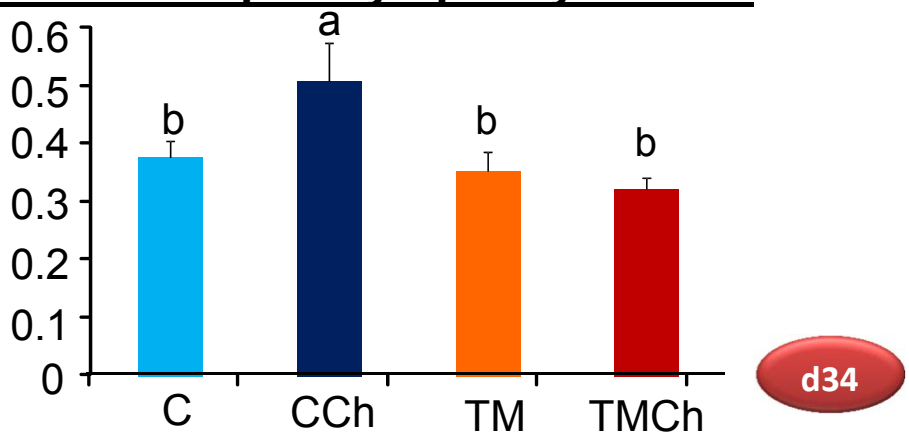
<u>Body temperature (Tb):</u>





Loyau et al., J. Anim. Sci., 2013

<u>Stress: Heterophil/Lymphocyte ratio:</u>



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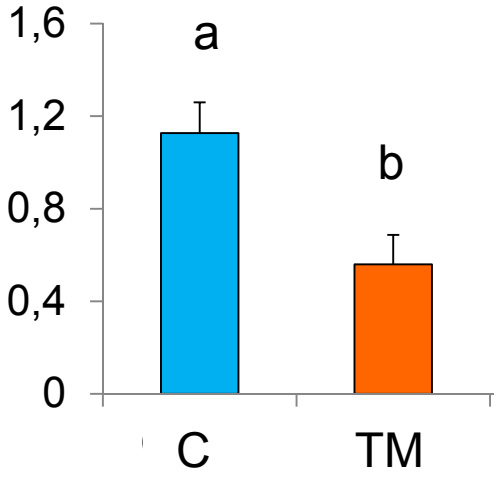
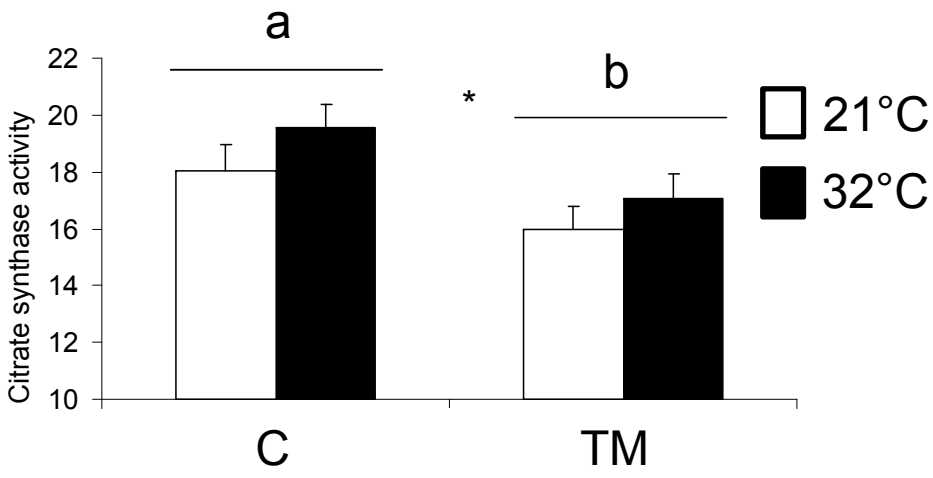
Regulation of energy metabolism

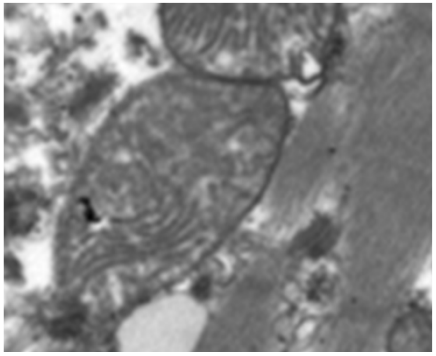
Muscle PGC-1α mRNA expression



Liver citrate synthase activity



Loyau et al., Plos One, 2014



B. Delaleu, INRA

Limitation of mitochondrial energy metabolism and heat production

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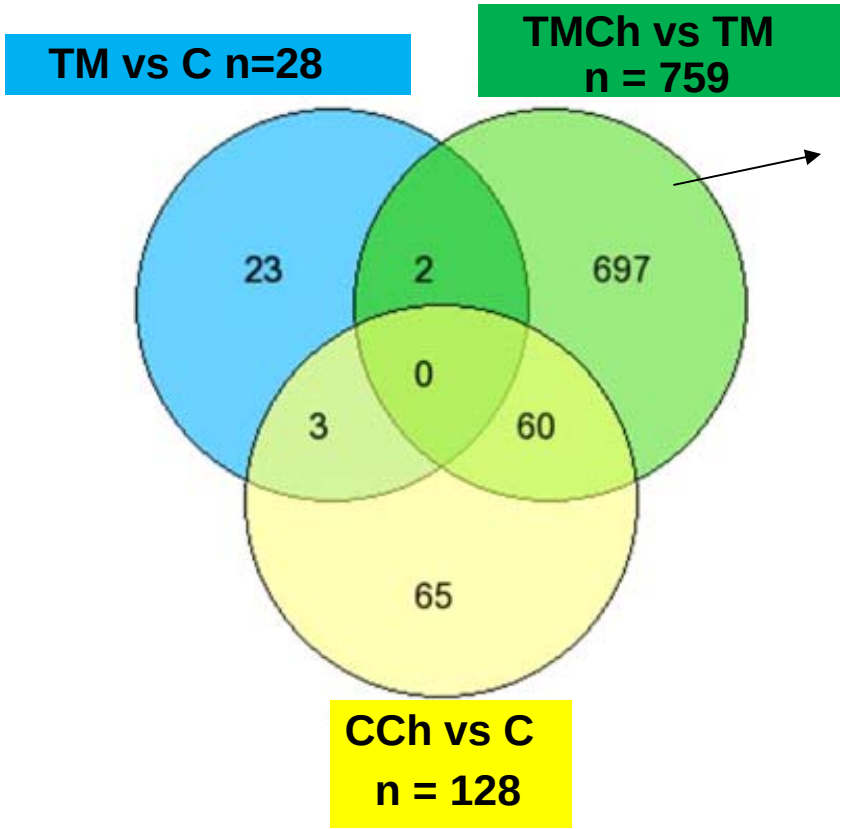
New markers of thermotolerance?

Gene expression analysis on microarray in breast muscle at d34



= earlier or more responsive!

- Metabolic regulations
- Chromatine modifications
- Vascularization
- Stress response

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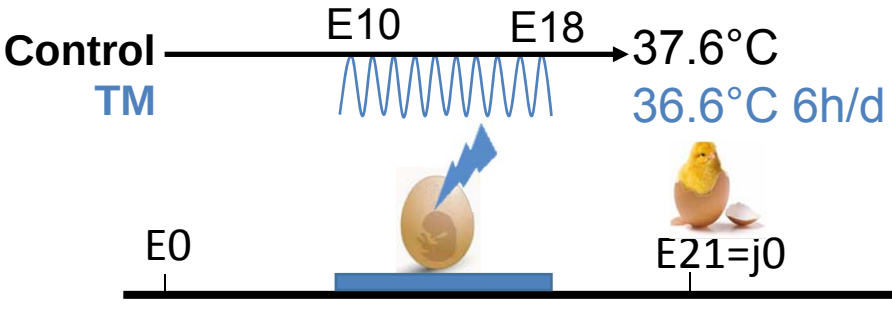
Cold incubation temperature

Cold manipulation during embryogenesis (TM)

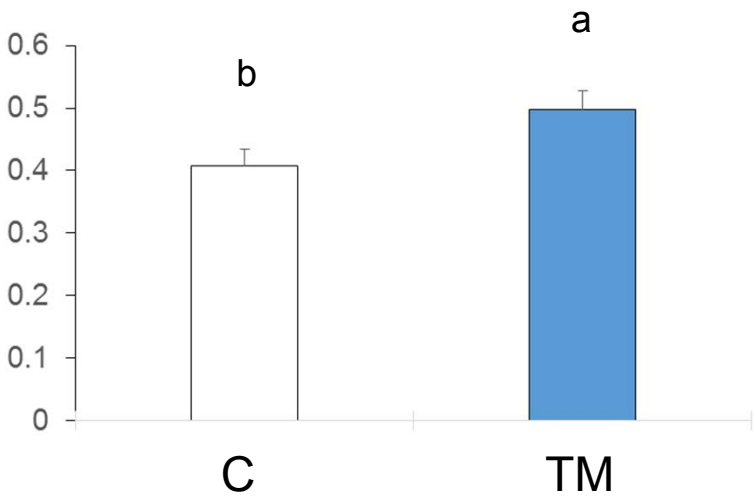


Better tolerance to cold

Yalçin et al., Poult. Sci., 2012

- ↗ anti-oxidant defense
- ↗ Tb at hatch and long term effects on the regulation of energy metabolism and heat production

PGC-1α/β-actin
Muscle



Loyau et al., Poult. Sci., 2014

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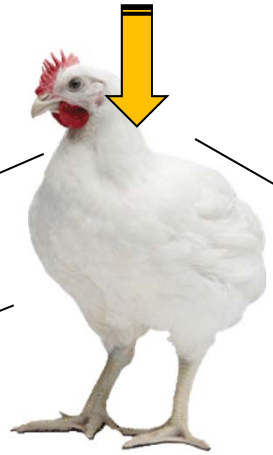
Variations in egg incubation temperature

Long-Lasting effects

Slight effect on performance, body composition, meat quality



Metabolic adaptations

↓

Changes in heat production?

Tb : Cold ↗, Heat ↘

↘ Stress markers

➡ **Better adaptability of chickens to changes in ambient temperature**

Can it be applied in the field?

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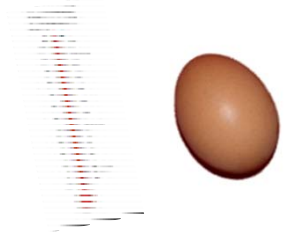
Loyau et al., Animal, 2015

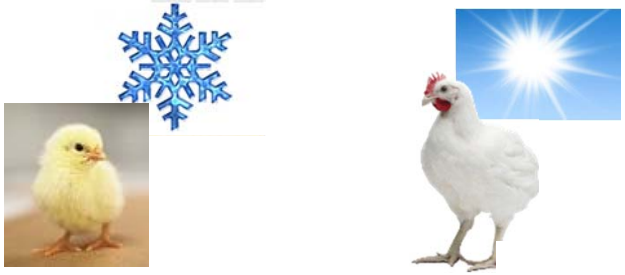
Multicriteria analysis and evaluation of such strategies

Three dimensions of sustainability:

Economical	Social	Environmental
Hatching rates Performance Meat quality Production costs…	Animal welfare Health and disease susceptibility Mortality…	Gas emissions Resource and energy use…

Incubation temperature × **Rearing conditions**





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POSTER #11 session L2.1

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INRA SCIENCE & IMPACT

Metaprogramme ACCAF
Adaptation of agriculture and forests to climate change

ReColAd network

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Ege University (Turkey)
Lomé University and ITRA (Togo)

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Project THERMOCHICK

ANR

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WAAPP / PPAAO

TUBITAK (project N°109O796)

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Thank you for your attention!