



HAL
open science

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

Thomas Loyau, Sonia Metayer-Coustard, Cécile Berri, Sandrine Mignon-Grasteau, Christelle Hennequet-Antier, Christophe Praud, Michel Jacques M.J. Duclos, Sophie Tesseraud, Vincent Coustham, Dzidzo Nyuiadzi, et al.

► To cite this version:

Thomas Loyau, Sonia Metayer-Coustard, Cécile Berri, Sandrine Mignon-Grasteau, Christelle Hennequet-Antier, et al.. Variations in egg incubation temperature enable chicken acclimation through long-lasting changes in energy metabolism. *Climate Smart Agriculture* 2015, Mar 2015, Montpellier, France. hal-02743909

HAL Id: hal-02743909

<https://hal.inrae.fr/hal-02743909>

Submitted on 3 Jun 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Le Corum, Montpellier, France

16-18 March 2015



Full programme

CLIMATE SMART Agriculture

2015

Third Global
Science
Conference



#CSA15

<http://csa2015.cirad.fr>

09:00 Livestock and climate change: combining mitigation and adaptation options and projecting sustainable futures

Soussana Jean-François¹ and the EC FP7 'AnimalChange' consortium (see www.animalchange.eu)
¹INRA, Paris, France

CONTRIBUTED ORAL PRESENTATIONS

11:00 Differential climate change impacts on crop and grasslands and the relative livestock production systems competitiveness

Havlik Petr¹, Leclere David¹, Valin Hugo¹, Herrero Mario², Schmid Erwin³, Obersteiner Michael⁴
¹International Institute for Applied Systems Analysis, Schlossplatz 1, A-2361 Laxenburg, Austria
²Commonwealth Scientific and Industrial Research Organisation 306 Carmody Road, St Lucia, 4067 QLD, Australia
³University of Natural Resources and Life Sciences, Feistmantelstraße 4, A-1180 Vienna, Austria

11:15 Efficiency gains for enteric methane mitigation and productivity: contribution to CSA and investment opportunities.

Gerber Pierre¹, Opio Carolyn¹, Mottet Anne¹, Steinfeld Henning¹, Hatton Victoria², Clark Harry²
¹Food and Agriculture Organization of the United Nations, Rome, Italy
²New Zealand Agricultural Greenhouse Gas Research Centre, Palmerston North, New Zealand

11:30 Variations in egg incubation temperature enable chicken acclimation through long-lasting changes in energy metabolism

Loyau Thomas¹, Métyayer-Coustard Sonia¹, Berri Cécile¹, Mignon-Grasteau Sandrine¹, Hennequet-Antier Christelle¹, Praud Christophe¹, Duclos Michel J.¹, Tesseraud Sophie², Coustham Vincent³, Nyuiadzi Dzidzo^{3,2}, David Sarah-Anne⁴, Everaert Nadia^{3,4}, Siegel Paul B.⁵, Yalçin Servet⁶, Yahav Shlomo⁷, Collin Anne¹
¹INRA, UR83 Recherches Avicoles, F-37380, Nouzilly, France
²Institut Togolais de Recherche Agronomique (ITRA), BP 1163, Lomé, Togo
³KU Leuven, Department of Biosystems, B-3001 Leuven, Belgium
⁴University of Liège, Gembloux Agro-Bio Tech, Animal Science Unit, B-5030 Gembloux, Belgium
⁵Virginia Polytechnic Institute and State University, Department of Animal and Poultry Sciences, Blacksburg, Virginia 24061-0306, USA
⁶Ege University, Faculty of Agriculture, Department of Animal Science, 35100 Izmir, Turkey

⁷Institute of Animal Science, The Volcani Center, Bet Dagan P.O. Box 6, 50250, Israel

11:45 Impact of feeding strategies on GHG emissions, income over feed cost and economic efficiency on milk production

Inamagua-Uyaguari Juan Pablo¹, Jenet Andreas¹, Wattiaux Michel¹, Guerra Leonardo¹, Vilchez Sergio¹, Chacón-Cascante Adriana¹, Posada Karla¹, Barrantes Luz², Casasola Francisco¹, Villanueva Cristobal¹, Leon Hector⁴, Lapidus Daniel⁵
¹Centro Agronómico Tropical de Investigación y Enseñanza (CATIE), 30501 Turrialba, Costa Rica
²Universidad de Costa Rica, Centro de Investigación en Economía Agrícola y Desarrollo Agroempresarial (CIEDA) 141-2400 Costa Rica
³University of Wisconsin-Madison, USA
⁴Cooperativa Dos Pinos; 179-4060 Alajuela, Costa Rica
⁵U.S. Department of Agriculture, 1400 Independence Ave., S.W.; Washington, DC 20250 USA

**PARALLEL SESSION L3.4
CLIMATE-SMART LANDSCAPES,
WATERSHEDS AND TERRITORIES**

ROOM RONDELET

KEYNOTE PRESENTATIONS

08:30 Climate Smart Territories; what are they and how do we evaluate progress towards this goal?

Beer John¹, Louman Bastiaan¹, Mercado Leida¹, Scherr Sara², Van Etten Jacob³
¹CATIE, Costa Rica
²EcoAgriculture Partners, USA
³Bioversity International

09:00 Towards climate smart landscapes and watersheds

Oswald-Spring Úrsula
CRIM-UNAM, Mexico

CONTRIBUTED ORAL PRESENTATIONS

11:00 Prototyping climate-smart agricultural landscapes: a generic modelling framework and application in a tropical island

Blazy Jean-Marc¹, Chopin Pierre¹, Doré Thierry^{2,3}, Guindé Loïc¹, Paul Jacky¹, Sierra Jorge¹

CLIMATE-SMART
Agriculture
2015



Global Science Conference

March 16-18, 2015
Le Corum, Montpellier France

Parallel Session L3

Towards Climate-smart Solutions

Wednesday, 18 March 2015

8:30–12:30

11:30 Variations in egg incubation temperature enable chicken acclimation through long-lasting changes in energy metabolism

Loyau Thomas¹, Métayer-Coustard Sonia¹, Beri Cécile¹, Mignon-Grasteau Sandrine¹, Hennequet-Antier Christelle¹, Praud Christophe¹, Duclos Michel J.¹, Tesseraud Sophie¹, Coustham Vincent¹, Nyuiadzi Dzidzo^{2,3}, David Sarah-Anne¹, Everaert Nadia^{3,4}, Siegel Paul B.⁵, Yalçın Servet⁶, Yahav Shlomo⁷, Collin Anne¹

¹INRA, UR83 Recherches Avicoles, F-37380, Nouzilly, France

²Institut Togolais de Recherche Agronomique (ITRA), BP 1163, Lomé, Togo

³KU Leuven, Department of Biosystems, B-3001 Leuven, Belgium

⁴University of Liège, Gembloux Agro-Bio Tech, Animal Science Unit, B-5030 Gembloux, Belgium

⁵Virginia Polytechnic Institute and State University, Department of Animal and Poultry Sciences, Blacksburg, Virginia 24061-0306, USA

⁶Ege University, Faculty of Agriculture, Department of Animal Science, 35100 Izmir, Turkey

⁷Institute of Animal Science, The Volcani Center, Bet Dagan P.O. Box 6, 50250, Israel

11:45 Impact of feeding strategies on GHG emissions, income over feed cost and economic efficiency on milk production

Inamagua-Uyaguari Juan Pablo¹, Jenet Andreas¹, Wattiaux Michel¹, Guerra Leonardo¹, Vilchez Sergio¹, Chacón-Cascante Adriana¹, Posada Karla¹, Barrantes Luz¹, Casasola Francisco¹, Villanueva Cristobal¹, Leon Hector¹, Lapidus Daniel²

¹Centro Agronómico Tropical de Investigación y Enseñanza (CATIE), 30501 Turrialba, Costa Rica

²Universidad de Costa Rica, Centro de Investigación en Economía Agrícola y Desarrollo Agroempresarial (CIEDA) 141-2400 Costa Rica

³University of Wisconsin-Madison, USA

⁴Cooperativa Dos Pinos; 179-4060 Alajuela, Costa Rica

⁵U.S. Department of Agriculture; 1400 Independence Ave., S.W.; Washington, DC 20250 USA

PARALLEL SESSION L3.4 CLIMATE-SMART LANDSCAPES, WATERSHEDS AND TERRITORIES

KEYNOTE PRESENTATIONS

08:30 Climate Smart Territories; what are they and how do we evaluate progress towards this goal?

Beer John¹, Louman Bastiaan¹, Mercado Leida¹, Scherr Sara², Van Etten Jacob³

¹CATIE, Costa Rica

²EcoAgriculture Partners, USA

³Biodiversity International

09:00 Towards climate smart landscapes and watersheds

Oswald-Spring Úrsula

CRIM-UNAM, Mexico

CONTRIBUTED ORAL PRESENTATIONS

11:00 Prototyping climate-smart agricultural landscapes: a generic modelling framework and application in a tropical island

Blazy Jean-Marc¹, Chopin Pierre¹, Doré Thierry^{2,3}, Guindé Loïc¹, Paul Jacky¹, Sierra Jorge¹

¹INRA, UR1321 ASTRO Agrosystèmes tropicaux, F-97170 Petit-Bourg (Guadeloupe), France

²AgroParisTech, UMR 211 Agronomie, F-78850 Thiverval-Grignon, France

11:30 Variations in egg incubation temperature enable chicken acclimation through long-lasting changes in energy metabolism

Loyau Thomas¹, Métayer-Coustard Sonia², Berri Cécile³, Mignon-Grasteau Sandrine⁴, Hennequet-Antier Christelle⁵, Praud Christophe⁶, Duclos Michel J.⁷, Tesseraud Sophie⁸, Coustham Vincent⁹, Nyuiadzi Dzidzo¹⁰, David Sarah-Anne¹¹, Everaert Nadia¹², Siegel Paul B.¹³, Yalçın Servet¹⁴, Yahav Shlomo¹⁵, Collin Anne¹

¹INRA, UR83 Recherches Avicoles, F-37380, Nouzilly, France

²Institut Togolais de Recherche Agronomique (ITRA), BP 1163, Lomé, Togo

³KU Leuven, Department of Biosystems, B-3001 Leuven, Belgium

⁴University of Liège, Gembloux Agro-Bio Tech, Animal Science Unit, B-5030 Gembloux, Belgium

⁵Virginia Polytechnic Institute and State University, Department of Animal and Poultry Sciences, Blacksburg, Virginia 24061-0306, USA

⁶Ege University, Faculty of Agriculture, Department of Animal Science, 35100 Izmir, Turkey

⁷Institute of Animal Science, The Volcani Center, Bet Dagan P.O. Box 6, 50250, Israel

Poultry production has increased during recent decades in hot climates where extreme temperatures are predicted to occur more frequently than in Europe. To limit the negative effects of temperature fluctuations on performance and welfare of chickens, an innovative strategy inducing hot or cold acclimation of embryos was established. The long-term effects of changes in chicken egg incubation temperature were studied to understand the physiological and metabolic mechanisms involved in early acclimation, according to the objectives of INRA Metaprogramme ACCAF. Cyclic increases in egg incubation temperature had little effect on hatchability and performance but caused a decline in body temperature of males from hatching to 28 days. They affected plasma thyroid hormones concentrations that regulate heat production, and changed respiratory physiology and stress markers in the long term. Heritabilities were moderate for comb temperature during a heat challenge and the ratio of thyroid hormone concentrations T₃/T₄, suggesting traits relevant to consider in selecting for heat-tolerance in chickens. Chickens having experienced heat during incubation exhibited a lower stimulation of energy metabolism in the liver and breast muscle. Conversely, the use of cyclically cooler incubation temperatures triggered mechanisms limiting oxidative stress at hatching and had long-term effects on mechanisms promoting heat production. These regulations could involve epigenetic mechanisms, such as changes in the methylation status of DNA or histones modifications. Innovative strategies of egg incubation should now be evaluated according to criteria defining sustainability, including not only the effects of these practices on performances of poultry production systems, but also their environmental and social impacts in temperate and hot countries.

Studies were funded by ANR-09-JCJC-0015-01 THERMOCHICK and TUBITAK (project N°1090796), T.L. by MESR and ANR (France) and N.D. by PPAAO-Togo and ITRA.