

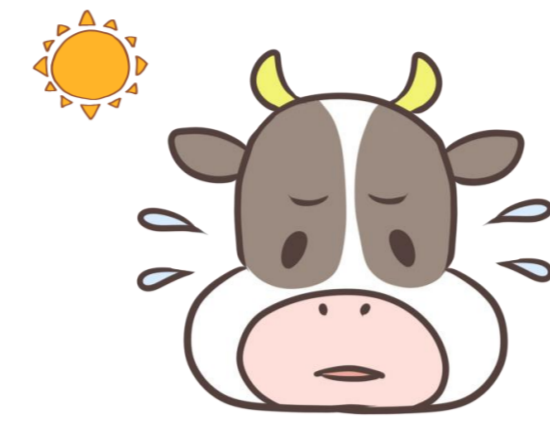
The effect of heat exposure on the growth and developmental competence of oocytes derived from early antral follicles in dairy cows

OKohei Kawano¹, Kenichiro Sakaguchi^{1,2}, Eri Furukawa¹, Madalitso Chelenga¹, Yojiro Yanagawa¹, Seiji Katagiri¹
 (1Faculty of Veterinary Medicine, Hokkaido University, Sapporo, Japan 2Institute of Cell Biology, The University of Edinburgh, Edinburgh, UK)

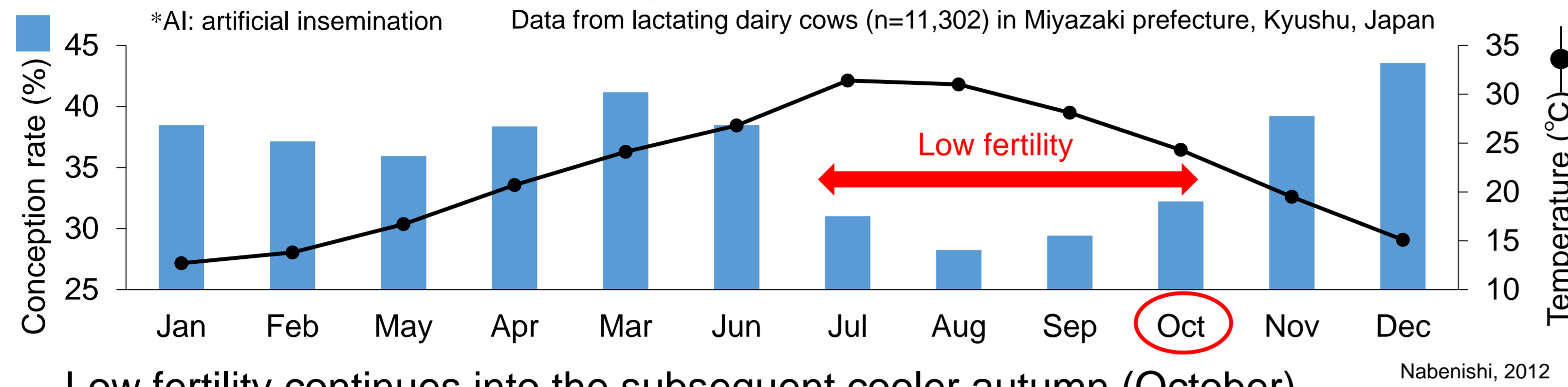
Introduction

Effect of summer heat stress on fertility in dairy cows

- Detection of estrus ↓ Abilay et al. 1975; Nebel et al. 1997; Thatcher & Collier, 1986
- Conception ↓ → Multifactorial causes Wolfenson, 2000; Hansen, 2009
 (Oocyte, early embryos, reproductive tracts...)



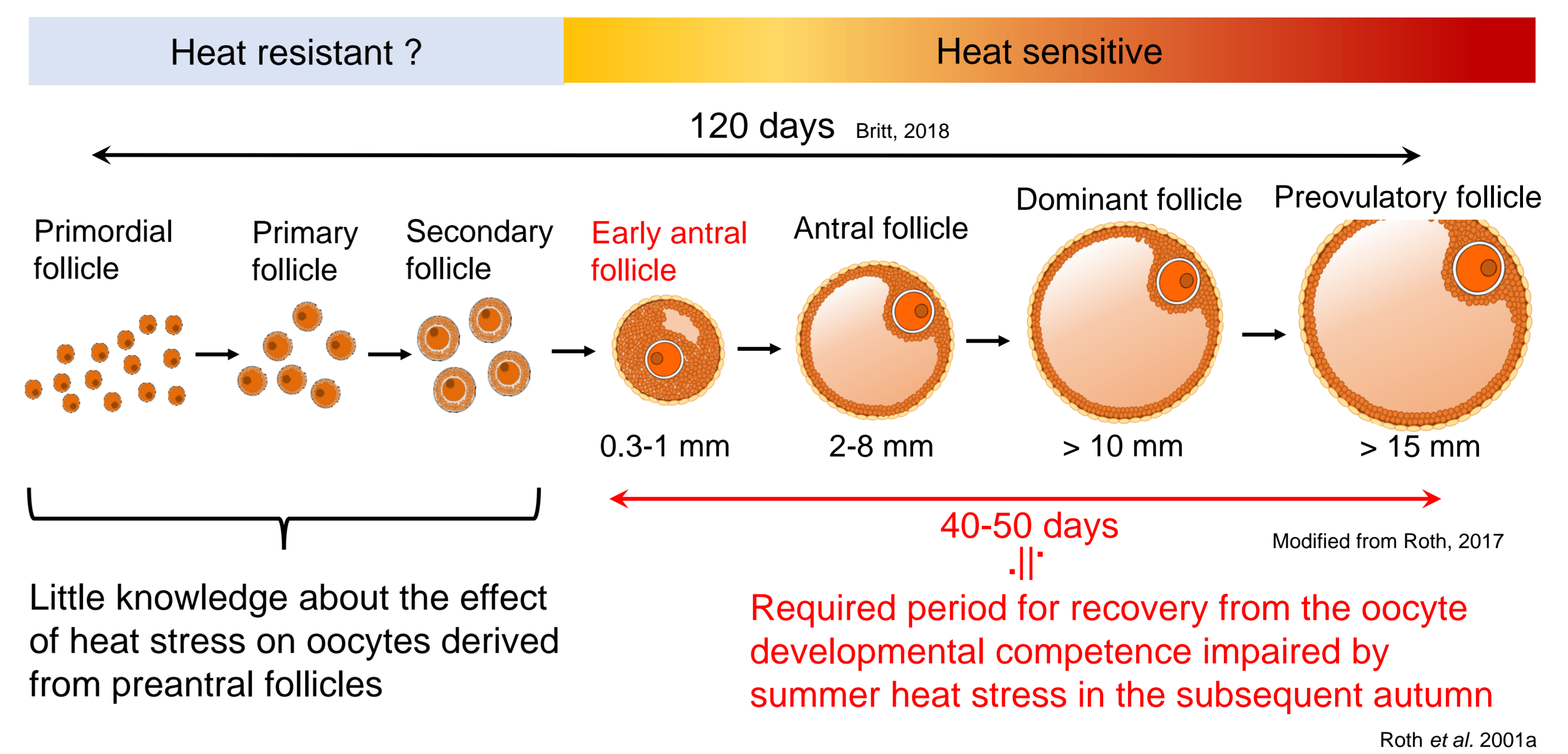
Conception rate after AI* in dairy cows and mean maximum temperature



Low fertility continues into the subsequent cooler autumn (October)
 Low oocyte quality and blastocyst rate after IVF** also continue into the autumn (Oocytes were collected from 2-8 mm follicles)

Summer heat stress is considered to impair the oocyte competence derived from small follicles (< 2 mm)

Thermal sensitivity of ovarian pool of follicles and their enclosed oocytes



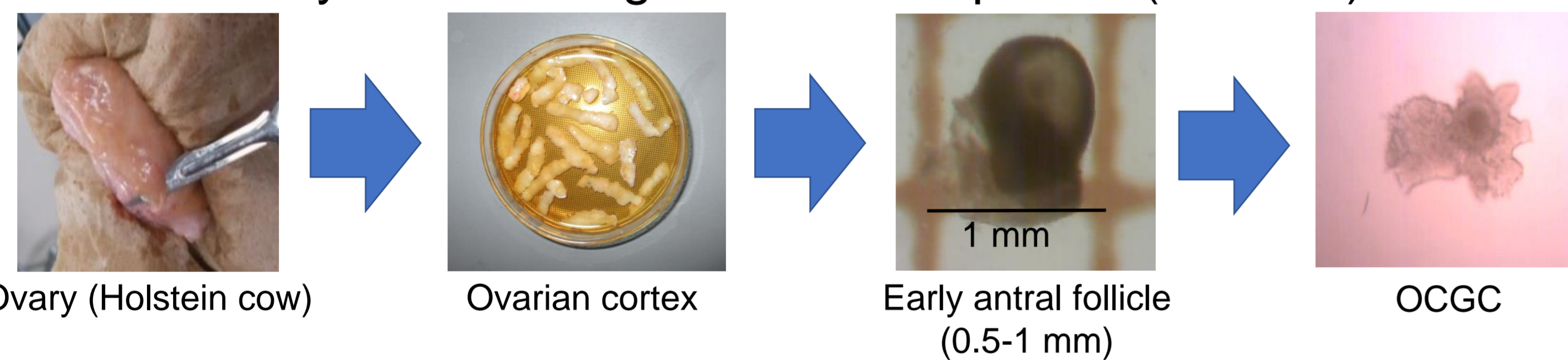
Effect of heat stress on the oocytes derived from early antral follicle may be linked to the decreased fertility during the cooler autumn

Objective

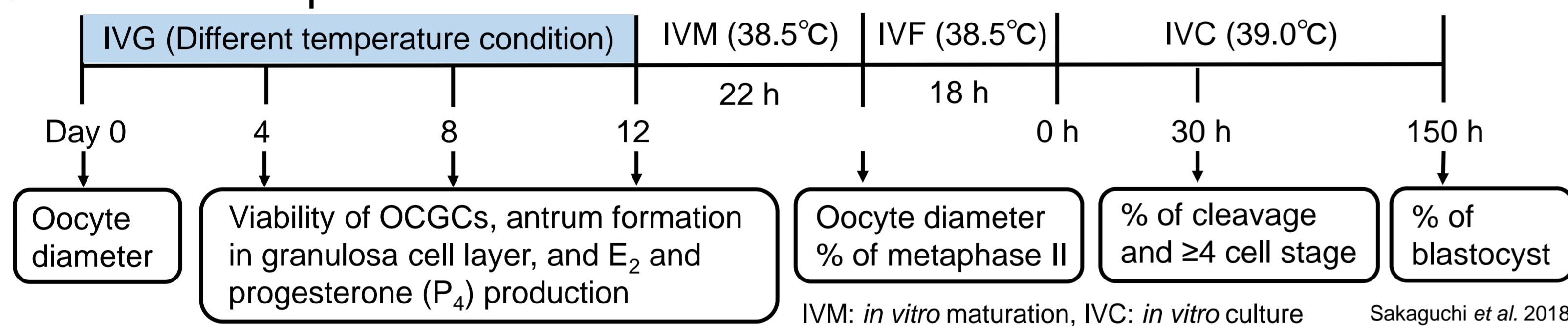
To investigate the effect of heat stress on the growth and developmental competence of oocytes using *in vitro* growth (IVG) culture of oocyte-cumulus-granulosa complexes (OCGCs) derived from early antral follicles (0.5-1 mm)

Materials and methods

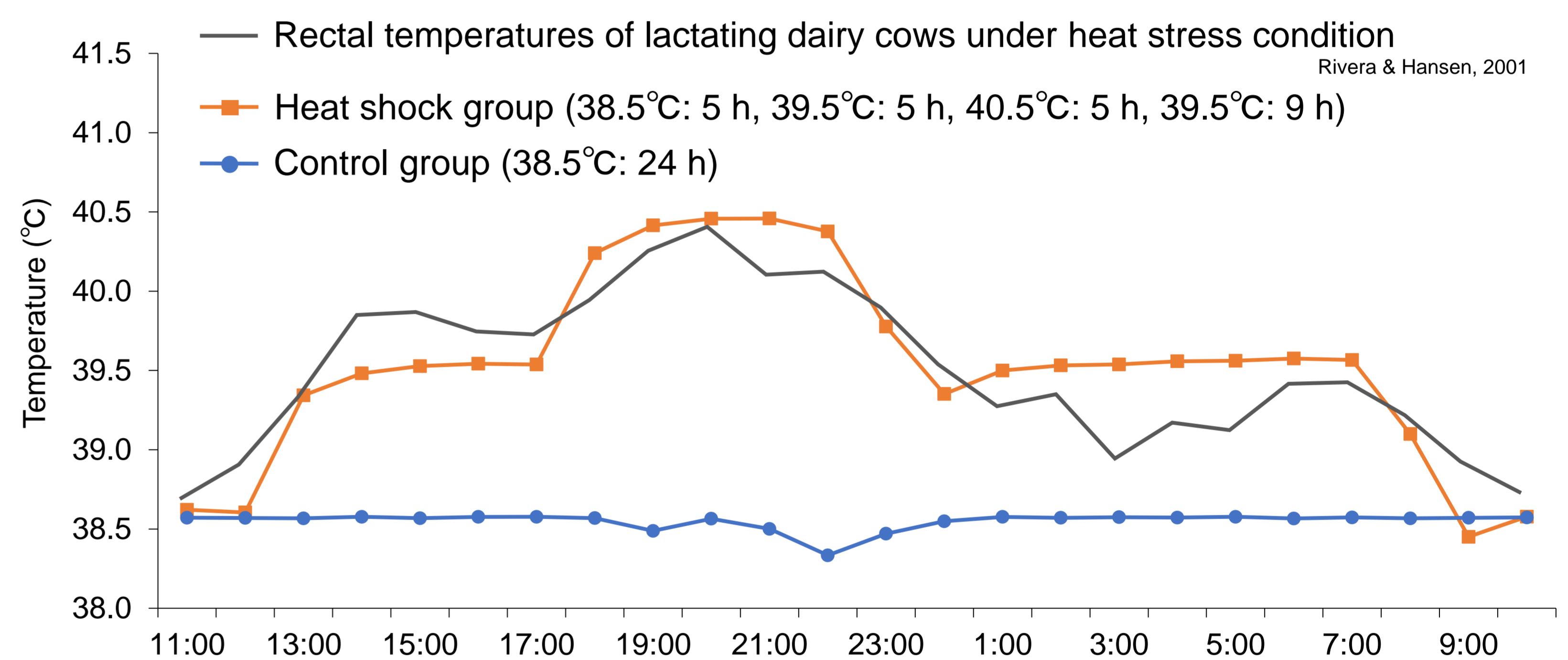
Collection of oocyte-cumulus-granulosa complexes (OCGCs)



Schedule of experiment

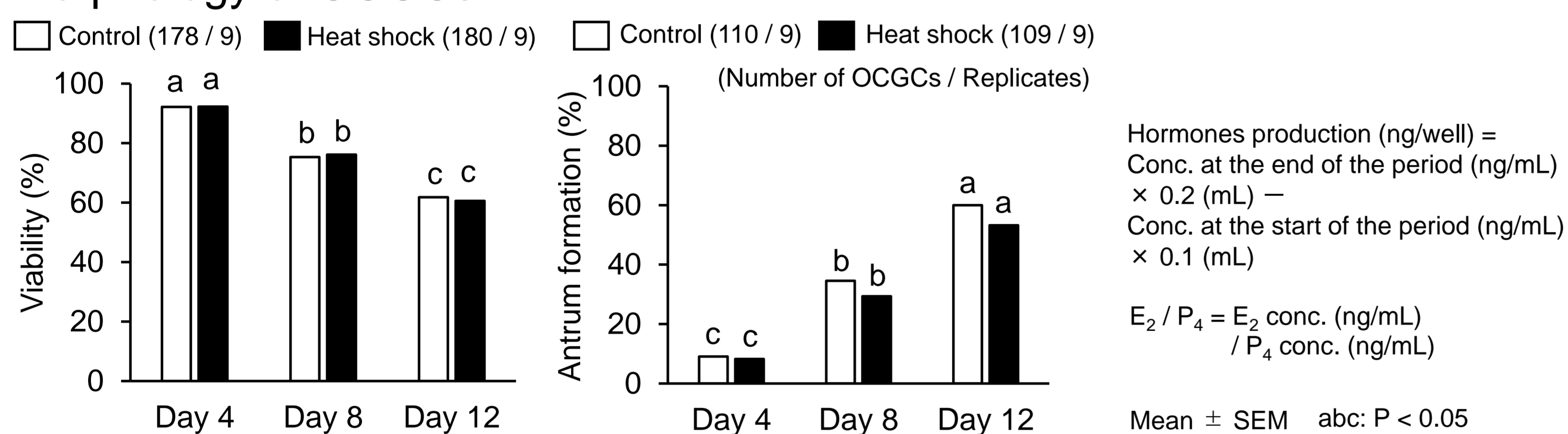


Temperature conditions during IVG culture of OCGCs

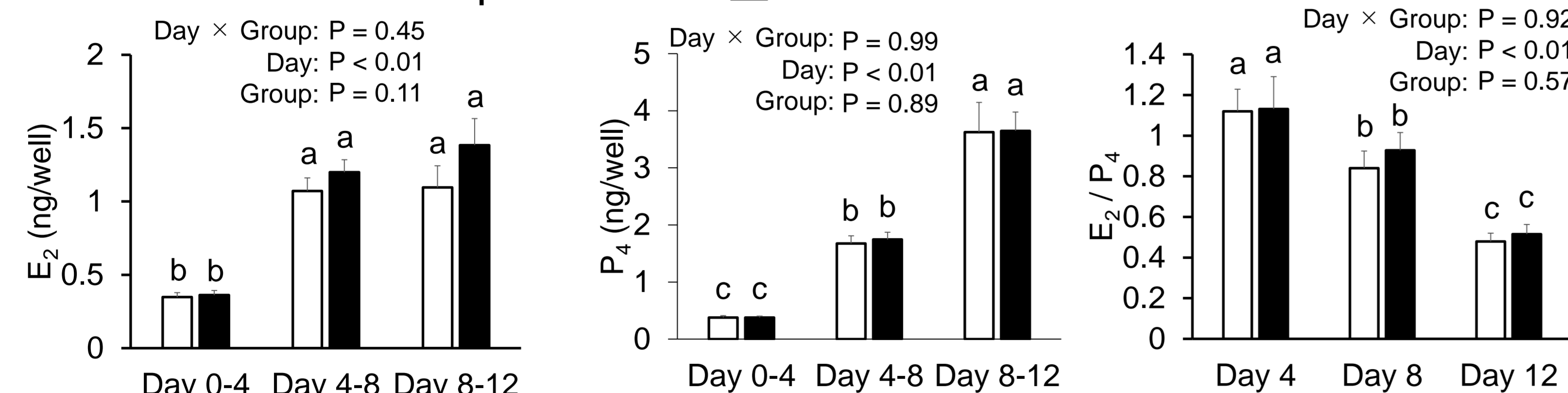


Results

Morphology of OCGCs

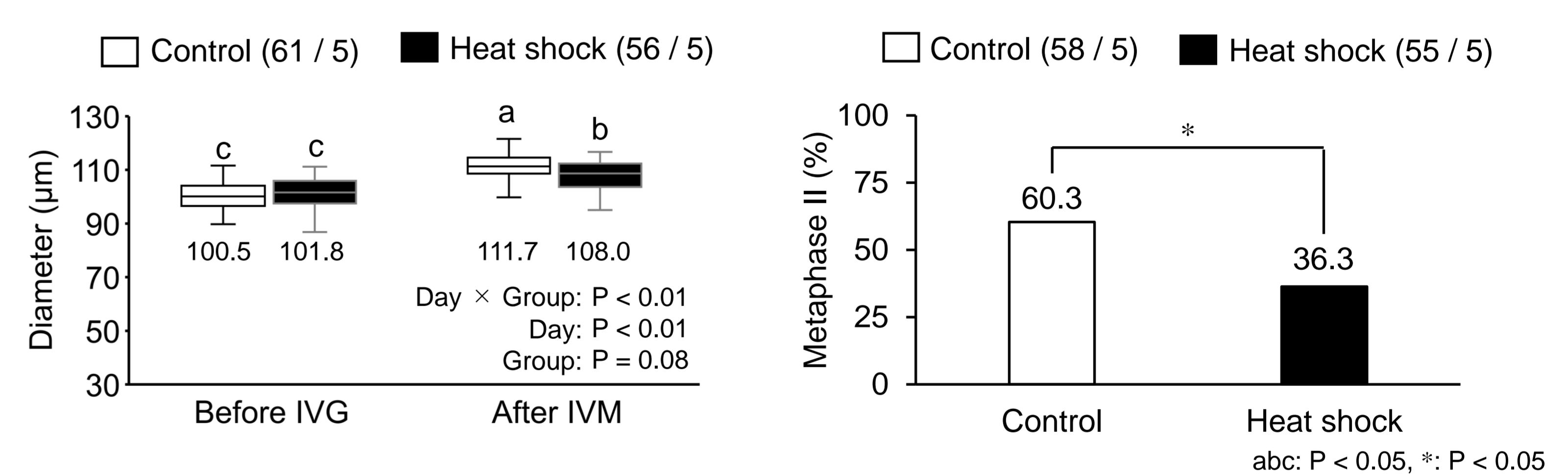


Sex steroid hormones production



✓ No difference in the viability of OCGCs, E₂ and P₄ production

Growth and nuclear maturation rate



Cleavage and blastocyst rate

Group	No. of oocytes (replicates)	Cleavage (%)	≥4 cell stage (%)	Blastocyst (%)
Control	47 (4)	55.3	28.3	27.7 ^a
Heat shock	48 (4)	45.8	14.3	0.0 ^b

ab: P < 0.05

✓ Heat shock decreased the growth and developmental competence of oocytes derived from early antral follicles

Discussions and conclusions

OCGCs derived from early antral follicles are thermosensitive, and the heat exposure during this stage decreases the developmental competence of oocytes (Growth, nuclear maturation rate and blastocyst rate ↓)

Cleavage rate was not different between the two groups
 Blastocyst rate was lower in the heat shock group
 → Similar with the result in conventional IVP system using *in vivo* grown oocytes collected in summer and winter
 → This experimental model can be used for examining the mechanisms by which summer heat stress impairs oocyte competence

Roth, 2018

Future study plans

In vitro study (by using the experimental model in this study)

- To investigate the mechanism by which heat stress impairs oocyte competence
- Evaluation of reactive oxygen species and reduced glutathione in cultured oocyte
- To explore antioxidants to ameliorate the impaired oocyte competence

In vivo study

- To examine the efficacy of treatments in dairy cows under heat stress condition

