

Assessing the β_1 : β_2 ratio of sensitized cardiac β adrenergic receptors in the embryonic cardiac tissue of hypoxia-treated Broiler chicken (*Gallus gallus domesticus*)

Alexandra Lee
Supervisor: Jordi Altimiras
IFM Biology, Linköping University,
Linköping, Sweden

Acknowledgements

Many thanks to my supervisor Associate Professor Jordi Altimiras and the CADE lab group at LiU for all their help, support and guidance during my work with this thesis.



Contact Information

Alexandra Lee

E-mail: alele697@student.liu.se

Website:

https://cms.ifm.liu.se/edu/biology/master_projects/2010/student-presentation-of-t/alexandra-lee/



Final Thesis 2010
International Masters Program
Molecular Genetics and Physiology



AVIAN
Behavioural Genomics
and Physiology group

Background

A developing embryo is sensitive to alterations and perturbation in the environment, that could potentially cause significant ramifications in the future growth and survivability of the organism as an adult.

β adrenergic receptors (β AR) modulate the inotropic and chronotropic activity of the heart. Catecholamines mediate the regulation of cardiac performance through the positive stimulation of these receptors. Under periods of stress, such as exposure to hypoxic conditions during embryonic growth, chronic elevated levels of circulating plasma catecholamines hyperstimulate the β ARs, triggering physiological changes in the heart. Mammalian and avian studies demonstrate that chronic prenatal hypoxia sensitizes β ARs in the embryonic heart but causes postnatal desensitization.

A potential explanation for these differences in sensitivity is a shift in the relative expression of β_1 AR and β_2 ARs, measured with respect to the relative gene expression of these receptors in the cardiomyocytes of the developing embryos at different developmental ages.

Method

32 fertilized Broiler eggs
8 incubated for 15 days (normoxia) E15N
8 incubated for 15 days (hypoxia) E15H
8 incubated for 19 days (normoxia) E19N
8 incubated for 19 days (hypoxia) E19H

With the first strand cDNA synthesized from the extracted mRNA from the samples, qPCR analysis of the β_1 AR, β_2 AR and housekeeper gene, GAPDH, mRNA expression levels was performed. The difference in mRNA expression of each gene was evaluated, normalized by the reference gene GAPDH from the qPCR results obtained.

Results

Effects of hypoxia on β AR expression: qPCR expression analysis reveals a significant increase in the number of β ARs for both β_1 and β_2 adrenergic receptors in the 15 day embryos, where there is a 10-fold difference in their expression in the hypoxic-treated relative to the normoxic-treated samples. This vast increase in β ARs in the hypoxic samples is not seen in the 19 day embryos.

Effects of age on hypoxic β AR expression: When comparing age there is a significant difference in the normalized relative $\beta_1:\beta_2$ adrenergic receptor ratio seen in the hypoxic samples. The relative $\beta_1:\beta_2$ expression increases in 15H but decreases in 19H, compared to the normoxic samples for each age.

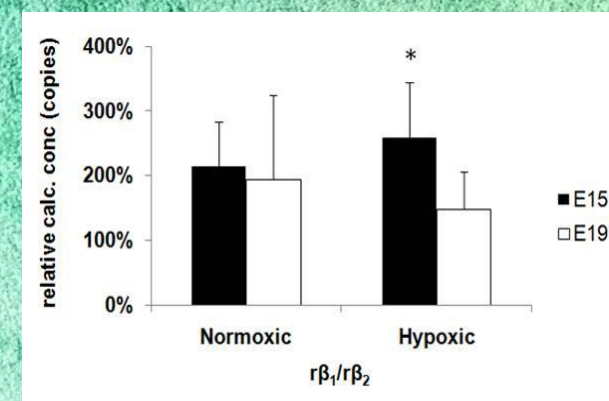


Figure 1. Relative expression of $\beta_1:\beta_2$ adrenergic receptors ($r\beta_1/r\beta_2$) of embryonic chicken cardiomyocytes exposed to normoxic or hypoxic conditions. ($P < 0.05$)

Conclusion

Chronic hypoxia alters the β AR subtype ratio in the heart, possibly explaining the changes in β ARs sensitivity pre- and postnatally in response to catecholaminergic hyperstimulation.