Translation control tunes *Drosophila* oogenesis

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Preface

This is an example of a thesis setup to use the reed thesis document class (for LaTeX) and the R bookdown package, in general.

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Abstract

All dynamic biological processes require control over transcription, translation, or post-translational products. Stem cells in particular require dynamic control of gene expression. My work has focused on characterizing this control, primarily at the translation level, to better understand how stem cell differentiation occurs. Stem cells are cells with the unique ability to develop into more specialized cell types in a process called differentiation. Some stem cell, including those focused on in my work, also have the ability to "self-renew," a process that allows one stem cell to copy itself giving rise to two stem cells. These processes must be carefully balanced as excess self-renewal will result in cells that do not give rise to differentiated cells necessary for further development or biological function. However, excess differentiation will result in the lack of an available pool of stem cells, preventing future differentiation and development. The decision of a stem cell to either self renew or differentiate is controlled by specific cellular pathways that can act at the level of transcription, translation, or post-translation. To study the regulation of these pathways in-vivo I have used the female *Drosophila* germline as a model system. The female *Drosophila* germline is contained within two pairs of ovaries. Ovaries consist of two main types of tissue, soma and germline. Each ovary is made up of strands called ovarioles. Ovarioles represent an assembly line of successive development. At the anterior tip of each ovariole a structure called a germarium is present. At the anterior of the germarium two to three stem cells are housed in a somatic niche. These germline stem cells (GSCs) can self-renew, or differentiate giving rise to a daughter cell called a cystoblast (CB). The CB turns on a differentiation factor called bag of marbles (bam). This CB then undergoes four incomplete cellular divisions, resulting in interconnected cysts consisting of two, four, eight, and finally sixteen cells. One of these cells is designated as the oocyte while the rest of the cells will become nurse cells. The sixteen cell cyst is then encapsulated by somatic cells, forming egg chambers. Egg chambers successively grow in size in fourteen stages. During this time the nurse cells produce mRNAs and proteins that are transported to the oocyte. The oocyte continues to grow, while the nurse cells eventually die, dumping their contents into the oocyte. Once the oocyte reaches the final, 14th stage it is known as an egg. Each of the steps from GSC to egg require changes in cellular pathways. These changes can occur at the level of transcription, translation, or post-translation. Decades of research has elucidated many of the changes that occur during oogenesis, however, many players in this process still remain mysterious. My work has helped to identify and characterize novel developmental mechanisms that are required for the successive developmental transitions that take place during oogenesis. I have leveraged RNAseq and polysome-seq to probe the global transcriptional and translational landscape over development. I have also used the power of *Drosophila* genetics in concert with these sequencing techniques to identify and characterize misregulated pathways.

Dedication

Dedicated to my wife and best friend Alli.

Introduction