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Examining How Ribosomal Proteins Affect Growth And Body Size

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Markin USRP
Undergraduate Student Research Program in Health & Wellness

Abstract

- An important aspect of growth is ribosome biogenesis.
- The ribosome is the molecular machine that is responsible for protein synthesis, hence growth.
- What still remains unclear is the contribution of rRNA and ribosomal proteins to tissue and body growth in developing animals.
- Using *Drosophila* as a model system, the experiments described showed that mutations in certain ribosomal proteins result in no change or an increase in overall body size of *Drosophila* pupae.
- The results showed a link to delayed development to the pupal stage, suggesting an explanation to the increased body size.

Introduction

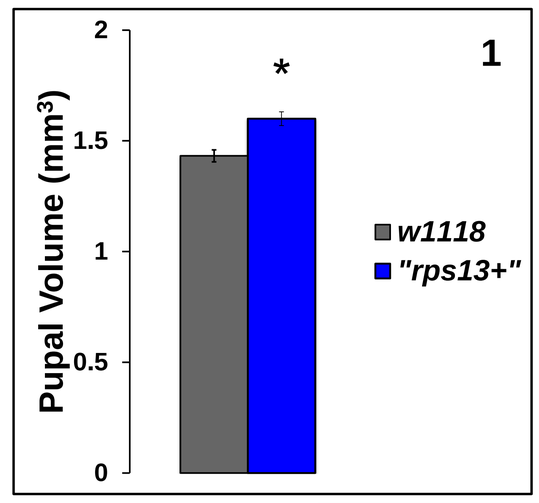
- All animals need adequate nutrition to grow and develop. Although the regulation of animal growth and size has fascinated many biologists, the underlying mechanisms still remain unclear. Getting a better understanding of the role of ribosomal proteins and rRNA in growth and development may help in diagnosing and treating disease related to abnormal development such as cancer and obesity.
- **Purpose**: to study the role of 5 specific ribosomal proteins in growth and development using *Drosophila* minutes.
- **Why use *Drosophila***? *Drosophila* is a powerful genetic model system to study cell and organismal responses to growth cues. Over a 4-day period, Drosophila larvae can grow over 200 fold in mass in response to nutrient availability.
- **What are Minutes**? They are flies that harbour mutations in different ribosomal proteins. They are lethal as homozygous mutants, however as heterozygotes they have a slow rate of development.
- **Hypothesis:** it was hypothesized that mutations in ribosomal proteins would result in decreased levels of ribosome and protein synthesis resulting in a decrease in overall body growth.

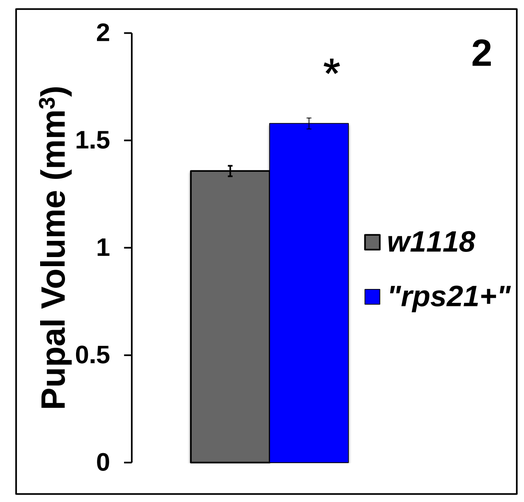
Methodology for pupal volume

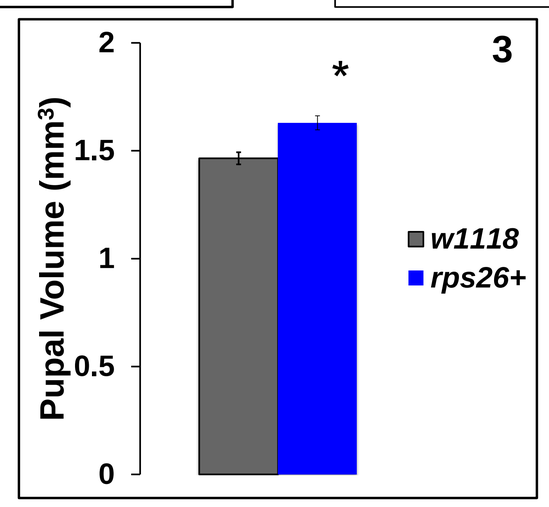
For this project 5 Minute strains were used. The pupal volume of each fly was used as an indication of body size.

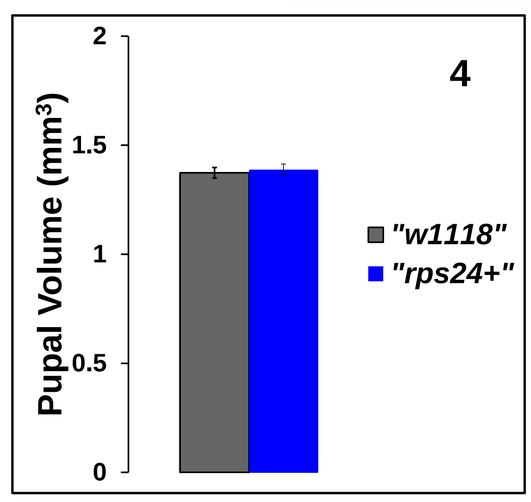
Propagate 5 Minute and control flies at 25°C on standard *Drosophila* media → Cross experimental Minute flies (place in a vial with a density of approximately 50 flies) with wild type virgin flies. → Overnight egg collection on grape plate for 5 Minute and control flies → Transfer 1 day old non-GFP larvae to labeled vials containing food. Place 50 larvae in each vial for each genotype → Wait for control and experimental larvae to reach pupal stage → Remove pupae on sides of the vial and align pupae on filter paper with the flat side of the fly on top of the paper → Take pictures of pupae and measure them using Axiovision software → Transfer all measurements to Microsoft Excel and calculate pupal volume

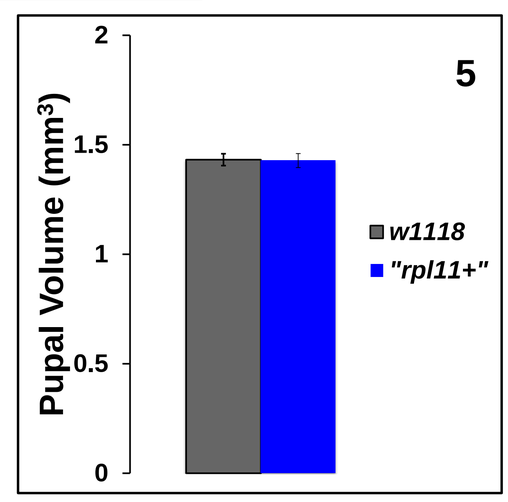
Results











Figures 1-5: Pooled pupal volume figures of multiple sets of experiments. Figures 1,3 & 5 show pooled data of 3 replicates and figures 2 & 4 show pooled data of 2 replicates. Error bars represent s.e.m. (*) indicates statistical significance calculated from t-test. $^{*}P = 9.60\times10^{-3}$, 3.60×10^{-9}, 4.27×10^{-9}, 0.58 and 0.43 for figures 1-5 respectively.

Conclusions

- The five Minute strains tested either increased in overall body size or had no increase in comparison to control.
- Rps13/+, Rps21/+ and Rps26/+ pupae show an increase in body growth in comparison to control
- RpL11/+ and rps24/+ pupae show no difference in body size in comparison to control.

Future Directions

- Look at restoring ribosomal protein levels in specific tissues to see if mutated ribosomal protein affected the function of a certain tissue affecting overall body growth.
- Conduct more experiments to find the specific role of *rpL11/+* and *rps24/+* in *Drosophila*.
- Run gels to measure rRNA levels in each minute strain to see if there is a correlation with rRNA levels and body growth patterns measured in the pupal volume experiments.

Significance

Ribosomal proteins play an important part in growth and this may be another target for prevalent diseases such as cancer and obesity.

References

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