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Comparative Physiology

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Results on the Effect of Sex, Size and Temperature on Metabolic Rate

Sex and Metabolic Rate

The impact of sex on the mass-specific metabolic rate of *Acheta domesticus* was assessed using a Welch Two Sample t-test to determine if there was a significant difference between male and female crickets. The analysis revealed that the difference in mean metabolic rates between the sexes was not statistically significant, with a p-value of 0.234. The box plot in Figure 1 illustrates that while males had a slightly higher median metabolic rate than females, the overlap in interquartile ranges indicates considerable variability within each group, supporting the statistical outcome that sex alone does not significantly affect the metabolic rate in crickets under the conditions tested.

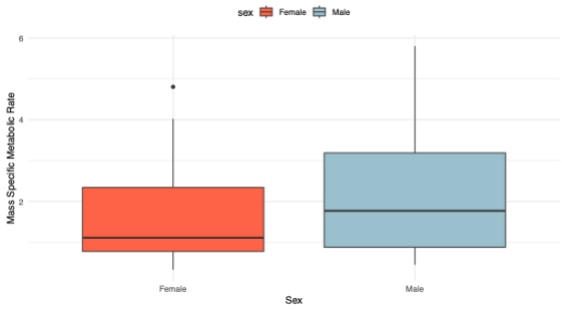

Figure 1: Box plot of mass-specific metabolic rates for male and female crickets. Boxes represent the interquartile range, with the horizontal line within each box indicating the median. p = 0.234.

Size and Metabolic Rate

To assess the effect of body size on mass-specific metabolic rate, a linear regression analysis was performed. The analysis yielded an R^2 value of 0.007843 and a p-value of 0.577, indicating no statistically significant relationship between body size and metabolic rate in *Acheta domesticus* (Fig. 2). As shown in Figure 2, the scatterplot of log-transformed body mass versus log-transformed metabolic rate reveals a slight negative slope; however, the low R^2 value suggests that body size accounts for minimal variation in metabolic rate.

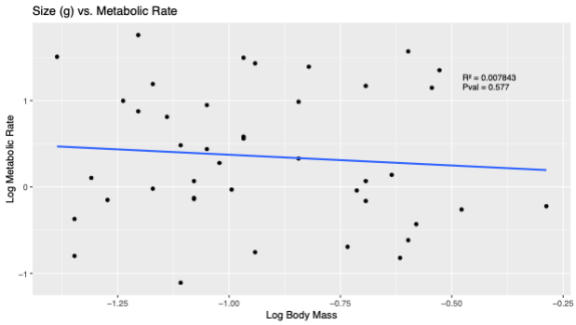

Figure 2: Relationship between log-transformed body mass and log-transformed mass-specific metabolic rate. Each point represents an individual cricket. The line represents the best-fit regression line. $R^2 = 0.007843$, $p = 0.577$.

Sex and Size and Metabolic Rate

To investigate a potential interaction between sex and body size on mass-specific metabolic rate, a linear regression analysis was performed separately for male and female crickets. For females, the analysis yielded an R^2 value of 0.007 with a p-value of 0.721, indicating no significant correlation between body size and metabolic rate. In males, the analysis produced an R^2 value of 0.043 with a p-value of 0.382, also showing no significant relationship between these variables (Fig. 3). The regression lines in Figure 3 demonstrate a slight positive trend for males and a slight negative trend for females, yet neither trend is statistically significant. These findings suggest that sex and body size do not interact to significantly influence metabolic rate in *Acheta domesticus*.

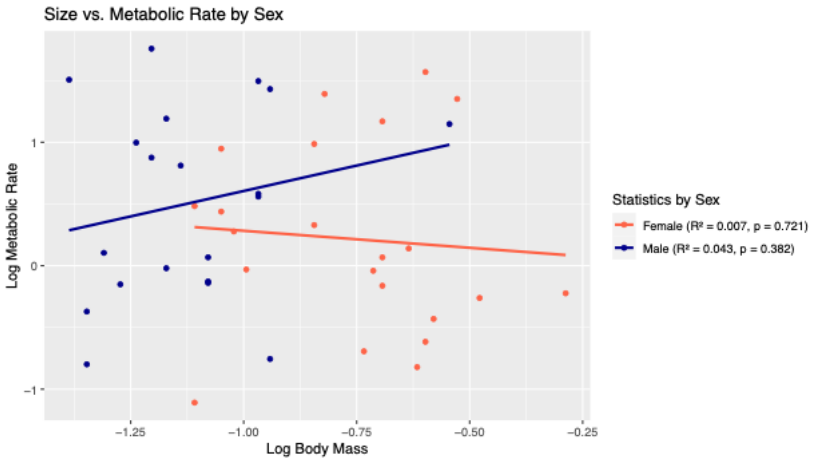

Figure 3: Relationship between log-transformed body mass and log-transformed mass-specific metabolic rate in male and female crickets Each point represents an individual cricket, with males in blue and females in red. Regression lines indicate the best-fit line for each sex. Female: $R^2 = 0.007$, $p = 0.721$; Male: $R^2 = 0.043$, $p = 0.382$.

Temperature and Metabolic Rate

The effect of temperature on the mass-specific metabolic rate of *Acheta domesticus* was evaluated by comparing crickets in room-temperature conditions with those in an ice bath. A Welch Two Sample t-test showed that crickets exposed to the ice bath had a significantly lower mean metabolic rate of 1.48, compared to 2.36 for crickets kept at room temperature ($p = 0.04973$). This statistically significant difference indicates that temperature has a substantial effect on metabolic rate, with lower temperatures resulting in decreased metabolic activity. Additionally, the Q10 value for this experiment was calculated as 1.52, suggesting a 52% increase in metabolic rate with a 10°C rise in temperature, which aligns with typical metabolic responses observed in ectothermic organisms (Fig. 4).

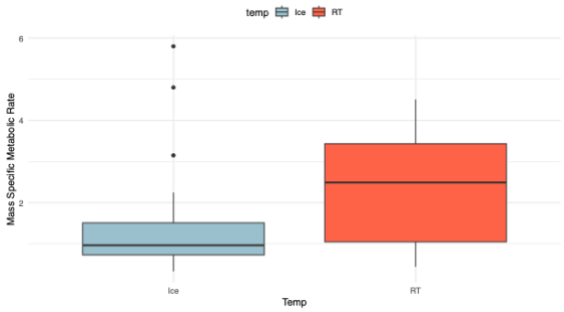

Figure 4: Mass-specific metabolic rate at room temperature (RT) and ice-bath (Ice) conditions. Boxes represent interquartile ranges, with median values marked by horizontal lines. p = 0.04973; calculated Q10 = 1.52.

Sex and Temperature and Metabolic rate

An analysis of variance (ANOVA) was conducted to examine the combined effects of sex and temperature on the mass-specific metabolic rate of *Acheta domesticus*. The ANOVA results indicated significant main effects for both temperature (Sum of Squares = 8.00667, df = 1) and sex (Sum of Squares = 2.66893, df = 1), suggesting that each factor independently influences metabolic rate. However, the interaction between sex and temperature was not statistically significant (Sum of Squares = 0.02822, df = 1, $p > 0.05$). This indicates that the effect of temperature on metabolic rate does not vary significantly between male and female crickets, as shown in Figure 5. Thus, sex and temperature appear to independently affect metabolic rate, without evidence of an additive or multiplicative interaction.

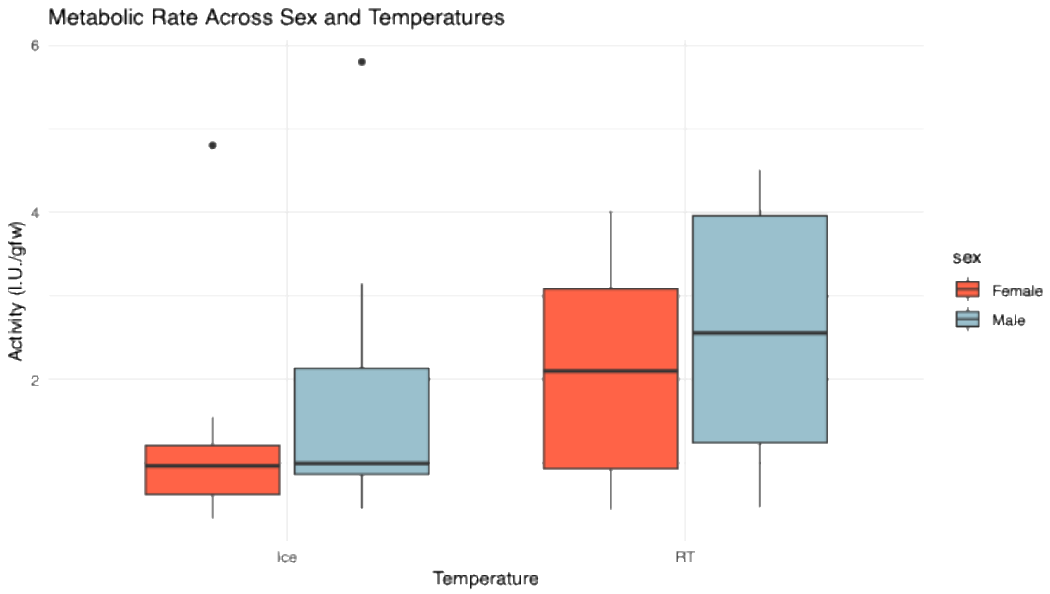

Figure 5: Mass-specific metabolic rate of male and female crickets at room temperature (RT) and ice-bath (Ice) conditions. Boxes represent interquartile ranges, with median values indicated by horizontal lines. ANOVA results show significant main effects of temperature and sex but no significant interaction between factors.

Size and Temperature and Metabolic Rate

The combined effect of body size and temperature on the mass-specific metabolic rate of *Acheta domesticus* was examined by performing a linear regression analysis separately for crickets in room-temperature and ice-bath conditions. In the room-temperature group, the analysis yielded an R^2 value of 0.112 and a p-value of 0.150, indicating no statistically significant relationship between body size and metabolic rate. However, as shown in Figure 6, the regression line for room temperature has a negative slope, suggesting a slight trend where larger crickets tend to have lower metabolic rates under room-temperature conditions, though this trend is not statistically significant.

Conversely, in the ice-bath group, the regression analysis produced an R^2 value of 0.016 with a p-value of 0.577, also indicating no significant correlation between size and metabolic rate. The regression line for the ice-bath condition shows a slight positive slope, suggesting a trend where larger crickets might exhibit slightly higher metabolic rates at colder temperatures, though again, this trend lacks statistical significance. The contrasting slopes between the two temperature conditions imply that temperature may slightly alter the direction of the relationship between

body size and metabolic rate. However, the low R^2 values and lack of statistical significance suggest that these trends are weak and should be interpreted with caution.

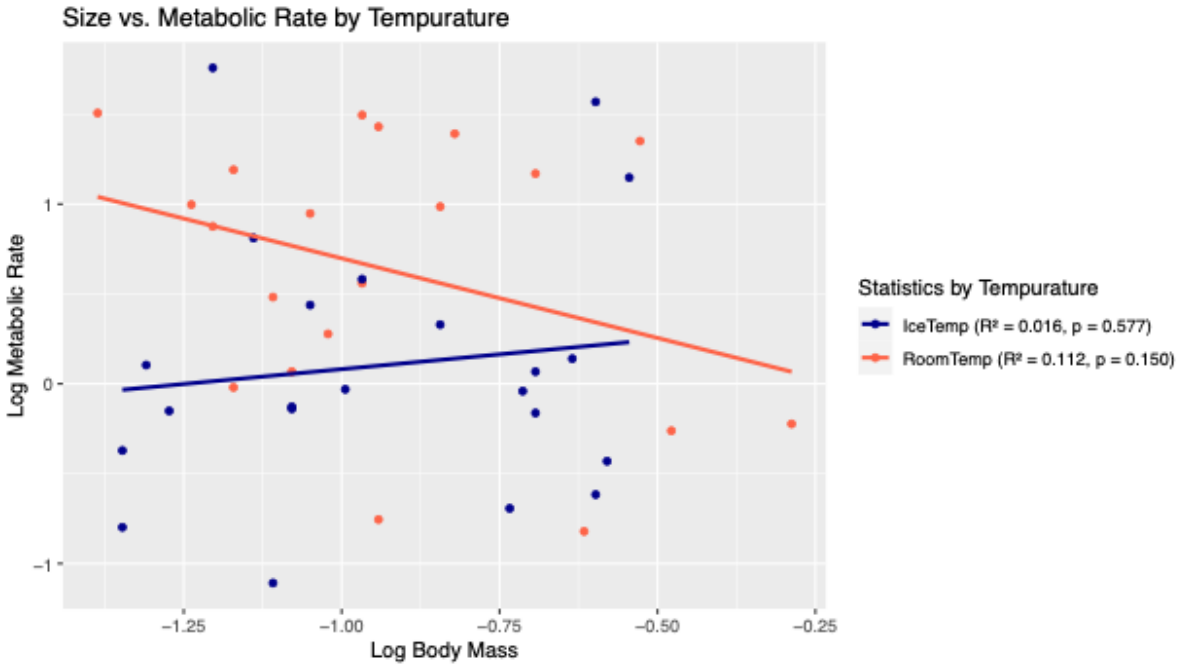

Figure 6: Relationship between log-transformed body mass and log-transformed mass-specific metabolic rate for crickets at room temperature (red) and ice-bath (blue) conditions. Each point represents an individual cricket. Regression lines indicate the best-fit line for each temperature group. Room Temperature: $R^2 = 0.112$, $p = 0.150$; Ice Bath: $R^2 = 0.016$, $p = 0.577$.