

# Analysis of Sex-Based Dietary Preferences of *Acheta domesticus* (L.) (Orthoptera: Gryllidae)

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**Abstract.** *Acheta domesticus* (L.) (Orthoptera: Gryllidae) is a species of cricket commonly used as a feeder insect. In addition, it has potential to be a valuable food source for humans, as it provides excellent nutritional value. To rear these insects properly, it is crucial to provide the best nutrition possible to ensure maximum nutritional value and to achieve a high developmental rate. Past research existed on the dietary preferences of crickets, however, there was a lack of research concerning *A. domesticus*. In this experiment, ratios of carbohydrates and protein were compared to determine if there was a significant difference between the dietary preferences of male and female *A. domesticus*. This was accomplished by giving protein powder and saltines to produce ratios of 5:1, 5.5:1, 6:1, and 6.5:1 of carbohydrates and protein to male and female crickets separated by sex. However, there was not a significant difference between male and female dietary preferences.

*Keywords: Acheta domesticus, nutrition, sex-based dietary preferences*

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*Acheta domesticus* (L.) (Orthoptera: Gryllidae) is a commercially available cricket species and has potentially far-reaching impacts on humans around the world. This particular species is commonly used as a feeder insect for various domesticated animals, as it is widely available and inexpensive. (Bawa et al. 2020) It also has the potential to be used as food for humans around the world. Crickets in general are considered to be nutritious and provide high levels of important macromolecules,

especially protein, compared to more conventional food sources, such as chicken and beef. (Finke 2002) These qualities, along with the shift in public sentiment towards more environmentally friendly methods of food production, make crickets and other insects good candidates for replacing cattle and other common livestock as protein sources. (van Huis 2020; Magara et al., 2021) To effectively mass produce crickets such as *A. domesticus*, it is crucial to use the best conditions possible. This can be

accomplished by various means, such as providing a quality environment and optimal nutrition. The primary focus of this experiment was on the nutritional preferences of *A. domesticus*. The diet of crickets influences the levels of proteins, lipids, and carbohydrates that can be recovered by the organism consuming them. (Bawa et al. 2020) While crickets are relatively generalist in their food preferences, certain diets favor higher rates of growth and development. Carbohydrates and proteins have been shown to be key macronutrients in the diet of crickets, however, there is a knowledge gap regarding these macronutrients in *A. domesticus*. (Clark 2014; Maklakov 2008) Past studies have indicated that crickets exhibit preferences for food with a higher ratio of carbohydrates compared to proteins. It should be noted that while female crickets prefer carbohydrate-rich diets, they grow more rapidly when given diets with relatively higher levels of protein. This may be due to sexual dimorphism, as female insects are generally larger than males and typically expend more energy as they must produce eggs. (Gutiérrez 2020; Han 2016; Kang 2022; Morales-Ramos 2020) However, it does appear that there is a limit to the level of protein that is beneficial to the developmental rate of *A. domesticus*, and research has shown

that high-protein diets do not always result in the highest growth rate. (Sorjonen 2019)

### **Materials and methods**

Forty adult *Acheta domesticus* (Linnaeus) (Orthoptera: Gryllidae) were purchased from a local pet store (Petco, San Diego, CA). The crickets were subsequently separated by sex and housed in 32-quart plastic boxes (Sterilite, Townsend, MA). A carbohydrate-protein mixture was prepared by mixing Serious Mass protein powder (Optimum Nutrition, Downers Grove, IL) with saltine crackers (Nabisco, East Hanover, NJ). The crackers and protein powder were mixed to yield a ratio of protein to carbohydrates of 1:5, 1:5.5, 1:6, and 1:6.5. This was accomplished by placing 50 grams of protein powder with increasing amounts of crackers to match the ratio in a blender (Sunbeam Products, Boca Raton, FL) along with approximately 50 mL of water to assist the blending process. It should be noted that the protein powder used had a protein-to-carbohydrate ratio slightly above 1:5 by itself, and thus did not necessitate the addition of any bread. The four mixtures were placed on labeled saran wrap (Glad Products Company, Oakland, CA) and distributed in plastic containers containing the crickets. The experiment was allowed to

run for 30 minutes. This procedure was repeated two more times and the results were compiled and analyzed using a two-way ANOVA with replication.

### Results

Comparing the dietary preferences of *A. domesticus* showed no significant difference in preference for different ratios of carbohydrates and proteins. Across the three repetitions, 12 female crickets were observed feeding on a 5:1 ratio of carbohydrates to proteins, whereas 24 males were observed feeding. Three females and 10 males were

observed feeding on the 5.5:1 ratio. Twenty-two females and 12 males were observed feeding on the 6:1 ratio. Two females and two males were observed feeding on the 6.5:1 ratio. This data can be seen in Figure 1. A two-way ANOVA with replication based on an association of sex-based diet preference indicated that while there was a significant difference in both sexes' preferences for certain treatments ( $F = 4.39, p = 0.019,$ ) there was not a significant difference between *A. domesticus* female and male dietary preferences based on carbohydrate to protein ratios ( $F = 0.358, p = 0.558$ )

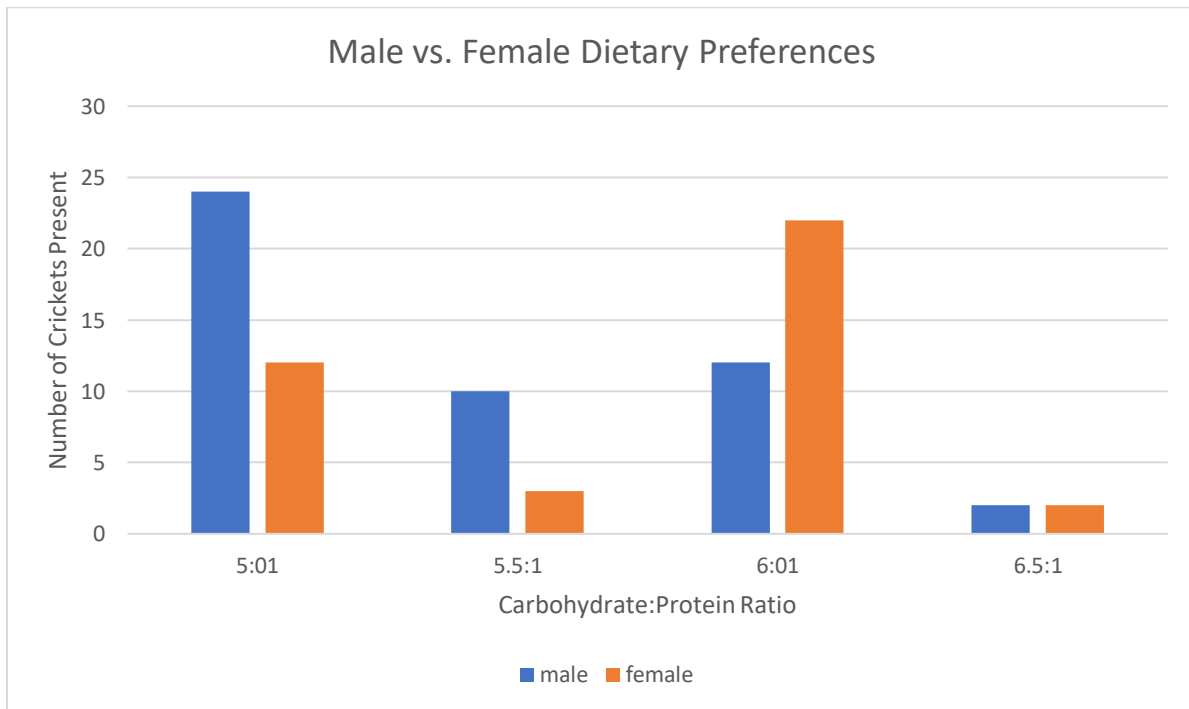


Figure 1: Number of males and females present at each ratio across three replicates. There was not a significant difference between male and female preferences ( $F = 0.358, p = 0.558$ )

## Discussion

This experiment failed to find a significant difference between the dietary preferences of *A. domesticus* males and females. This species is commonly used as a feeder insect, and ensuring optimum nutrition is crucial in maintaining the health and well-being of the animals feeding on the crickets. The results of this study would indicate that those rearing *A. domesticus* as feeder insects should not find it necessary to separate males and females to provide ideal nutritional requirements. The basis for the selected protein and carbohydrate ratios was based on a prior study involving *Gryllus bimaculatus* (De Geer) (Orthoptera: Gryllidae), another species of cricket in which males were found to prefer a 5.7:1 ratio of carbohydrates and protein. (Han 2016) It is possible that *A. domesticus* displays different preferences, however, that was not a primary objective of this experiment. It was thought that females would display a significantly higher preference for a higher protein diet, as had been the case in other Gryllids. (Maklakov et al. 2008) However, it should be noted that these two experiments differed quite significantly in their methods, as the previously referenced study utilized much more extreme differences between the ratios of proteins and carbohydrates, which could

have influenced differences in the results. The previously referenced study initially utilized 100% protein or carbohydrate diets before mixing the two macronutrients. Thus, it is possible that the differences in ratios used in this experiment were not sufficient to induce differences in feeding behavior between the two sexes. It is recommended that in the future, ratios with a more significant difference be used.

This experiment did face several limitations, most notably that not all of the crickets were observed feeding. The majority of crickets in each group seemed reluctant to feed. This would influence results, as it effectively decreased the number of experimental units involved in each replicate. Additionally, over the course of the experiment, several crickets expired and were consumed by other crickets, which aside from the obvious impact on the number of experimental units, also may have impacted the diet of several crickets.

While not time-conscious or financially efficient, in the future, it would be preferable to use individual housing for each cricket, rather than keeping 40 in the same container. As a result of the lack of participation exhibited by the crickets, it would also likely be beneficial to utilize appropriate food sources commonly preferred by *A.*

*domesticus*. Protein powder and saltine crackers were utilized because they were readily available. However, similar experiments have been successfully conducted for commercially produced cricket-specific diets. (Morales-Ramos et al. 2020, Bawa et al. 2020)

While the results of this experiment seem contrary to existing literature concerning

other species of field crickets, they should not be discounted. *A. domesticus* males and females may exhibit different dietary preferences, however, not within the range of protein and carbohydrate ratios provided in this experiment. For these reasons, it is recommended that future experiments utilize more replicates and more appropriate food sources.

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