# Food Preference in Two Domestic Populations of Young Blaptica Dubia (Serville, 1838) (Blattodea: Blaberidae)

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**Abstract**: *Blaptica dubia* (Serville, 1838) (Blattodea: Blaberidae), or the dubia roach, has become a popular feeder insect for reptiles and amphibians because of their low maintenance care and high protein content. Despite the growing popularity of captive dubia roaches as pets, research on this insect is sparse. This study aimed to fill a knowledge gap about the diet preference of dubia roach nymphs, under a month of age. It also aimed to compare possible differences in feeding behavior between two population samples from different dubia roach retail companies. One population was derived from Dubia Roach Depot (population A) (Berkeley, CA), and one from the All About Feeders (population B) (Chesterland, OH). Two plastic bins, housing one population in each, were placed with an equal amount of cat food (control), a banana, and cheese for a protein, carb, and fat, respectively. Seven trials were done, observing the feeding visitation rates for one hour, to determine food preference of each population. The results provided no significant differences (p-value <0.05) in the food preference within each population or between the two populations. These results could be important for understanding the generalist behavior of the *Blaptica dubia.* This can apply to insect production industries, and, potentially, pest management industries.

*Keywords: Blaptica dubia*, food attraction, population differentiation, preference

*Blaptica dubia* (Serville, 1838), is known as the dubia roach, tropical spotted roach, orange-spotted roach, or Guyana spotted cockroach. The dubia roach is large, up to 4.5 cm in length. *B. dubia* is also sexually dimorphic, with ovoviviparous females, who have some parental care behaviors and have reduced wings, while males have larger wings (Wu 2013). Dubia roaches don't develop an arolium between their tarsal claws, making it hard for them to climb smooth surfaces (Wu 2013). Generally, *B. dubia* has minimal odor and can reproduce well, while only taking up small amounts of space. *B. dubia* also tends to die off when living outside of their normal temperate conditions (higher heat and humidity).

The dubia roach has become a popular feeder insect for reptiles and amphibians and is rising as a poultry feeder, likely due to the easy care and high-quality source of protein that the roaches offer (Yi 2013 and Yee 2018). As a potential ingredient in animal feed, this insect could utilize organic waste for a nutrient source in its growth and development and thus provide a cheap protein source for agriculture producers compared to traditional livestock feed. A study by Yi, found dubia roaches to have 19% to 22% crude protein comparable to conventional meat products and amino acids that are comparable to soy only with a lower casein level (Yi 2013). Yee found that male and female adults and unsexed nymphs of the dubia roach had 47.50-54.32% crude protein, and a moisture content, ash, chitin, and fat comparable to alternative animal feed ingredients (Yee 2018). Since they are suitable for animal feed, more information to refine dubia roach rearing practices, like what they prefer to eat at different life stages, is important.

The roach's popularity as a pet has driven bans on the roach in Hawaii, Florida, and Canada for preventative measures to ensure there is not an invasive outbreak. There has been only one documented sighting of a *B. dubia* colony with an estimated origin of release or escape that was established in Funabashi, Chiba, Japan, for about two years (Kato and Yamasako 2021). With many unknowns about the *B. dubia* that live in wild populations and the chance of invasive establishment, more research is needed to confirm their risks and formulate possible preventative strategies around those risks.

In the United States, integrated pest management (IPM) practices or reduced-risk insecticide tactics (e.g. baits) are used to control domestic roaches, like the German cockroach (*Blattella germanica)* (Linneaus) (Blattodea: Ectobiidae), and peridomestic roaches, like the American cockroach (Gondhalekar 2021). For a bait to succeed in capturing the intended pest, it's important to know what attracts the insect and increases its likelihood of consuming that bait. Along with bait preferences, the behavioral resistance to bait types has also been documented among species like *Blattella germanica*, where different field strains of the cockroach can be more or less resistant to specific bait ingredients or insecticides through selection processes on the populations (Gondhalekar 2010). Population differences among these roaches are thus important in estimating the success of a bait.

This study hypothesizes that young *B. dubia* will display different macronutrient preferences for protein sources because of their development needs and that there will be food preference differences among the two strains or populations of young *B. dubia*. The objectives of this study aimed to (1) test the food preference (defined by the number of visits) of lower instars of B. dubia and (2) determine if two populations from different dubia roach companies displayed differences in food preference. These objectives aim to answer questions about food preference for the benefit of insect production and pest management viewpoints.

## Material and Methods

### *Insects*

Two experimental groups of cockroaches were purchased from two different companies, listed as ¼ inch and about a week old at max (Dubia Roach Depot, Berkeley, CA) for population A and ⅛ inch in length and three weeks old at max (All About Feeders, Chesterland, OH) for population B . Upon arrival, the cockroaches were placed in a respective plastic container (41.4 x 55.6 x 31.8 cm) (Rubbermaid) (Atlanta, Ga) and maintained under a 12:12-h light:dark photoperiod at about 23ºC and relative humidity. The cockroaches were provided shelter (egg crates), cat food (Indoor Complete Cat Food, H-E-B Texas Pets®, H-E-B Grocery Company, LP, San Antonio, TX), and water on an ad libitum basis. The colonies were given a week of acclimation until the experimental process began.

***Test for feeding preference***

A total of two arenas were used for each of the six trials conducted, one for population A and one for population B (n=360). The arenas were held in a dark room under an artificial 12:12-h light:dark photoperiod at about 23ºC and relative humidity. Each arena was plastic and had a middle area for food treatments. Thirty young nymphs were randomly selected from each population and placed in one arena allocated to their population group. The nymphs were without food for three days before the test to ensure hunger and willingness to consume food. Each trial involved a ten-minute acclimation period within the nymphs respective arena. After the acclimation, the treatments were randomly placed. Each trial went on for an hour, and the visitation rates, defined by a nymph physically stopping at a food group, were noted. A peeled banana, Musa acuminata linn., was used for the carbohydrate group,Swiss cheese (Hill Country Fare®) for the protein group, and cat food for the control group (H-E-B Grocery Company, LP, San Antonio, TX). These food groups were placed randomly in a vertical line parallel to the longest side of the container in the middle of the containers at about 0.2 grams each.

***Statistical Analysis***

A Pearson's Chi-squared test analysis was performed to measure the significance of the food preferences within populations A and B, the populations to one another, and the differences in the trials.

**Results**

The Chi-squared statistical analysis resulted in insignificant ($p \geq 0.05$) values for the visitation rates for each food type in each population. Population A preferred cheese (7 ± 4.65) (Mean visits ± 95%CI), cat food (5.33 ± 4.18), and banana (4.66 ± 0.857) at insignificant values ($p \leq 0.775$), and Population B preferred cat food (5.5 ± 4.34), cheese (4 ± 2.65), and banana (3.5 ± 2.07) at insignificant values ($p \leq 0.7788$), respectfully (Fig. 1). Population A and Population B were not significant when compared to one another ($p \leq 0.250$) (Fig. 1).

Due to limitations in resources, two total replicates, one for each population, were used six times simultaneously to make six trials instead of three replicates per population once. Comparing trial counts resulted in significant data for Population A trials one and five. In trial one, cat food was significantly preferred ($p \leq 0.050$), and in trial five, cheese was significantly preferred ($p \leq 0.032$) (Fig. 2). No trials within Population B showed significant visitation values (Figure 3).

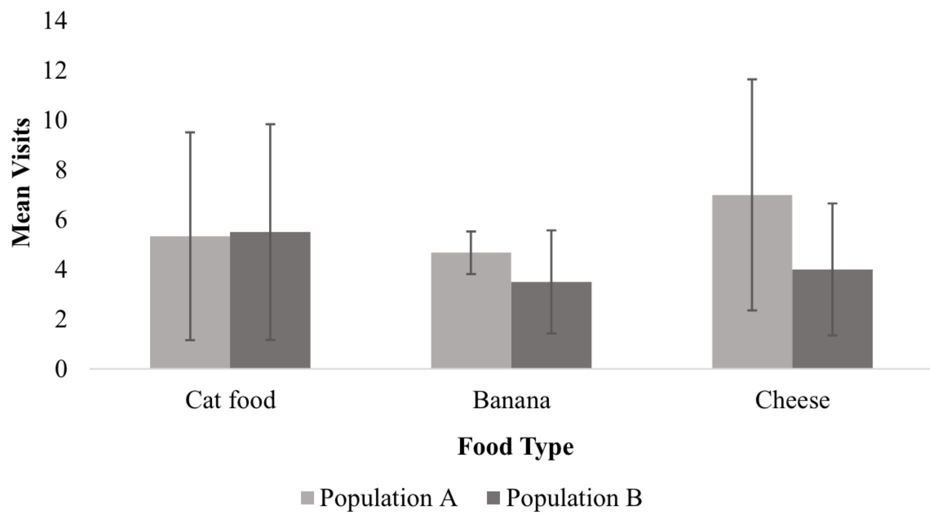


Fig. 1. Amount of mean visits on cat food, banana, or cheese within two populations of dubia roaches from six trials (n=360). A Pearson's chi-squared test was used for all of the following calculations. Population A had insignificant visitation rates between food types ($p \leq 0.775$, $\chi 2=0.5098$, d.f.=2). Population B had insignificant visitation rates between food types ($p \leq 0.779$, $\chi 2=0.5$, d.f. = 2). Population A and Population B had insignificant visitation rates compared to one another ($p \leq 0.250$, $\chi 2=2.7738$, d.f. = 2)

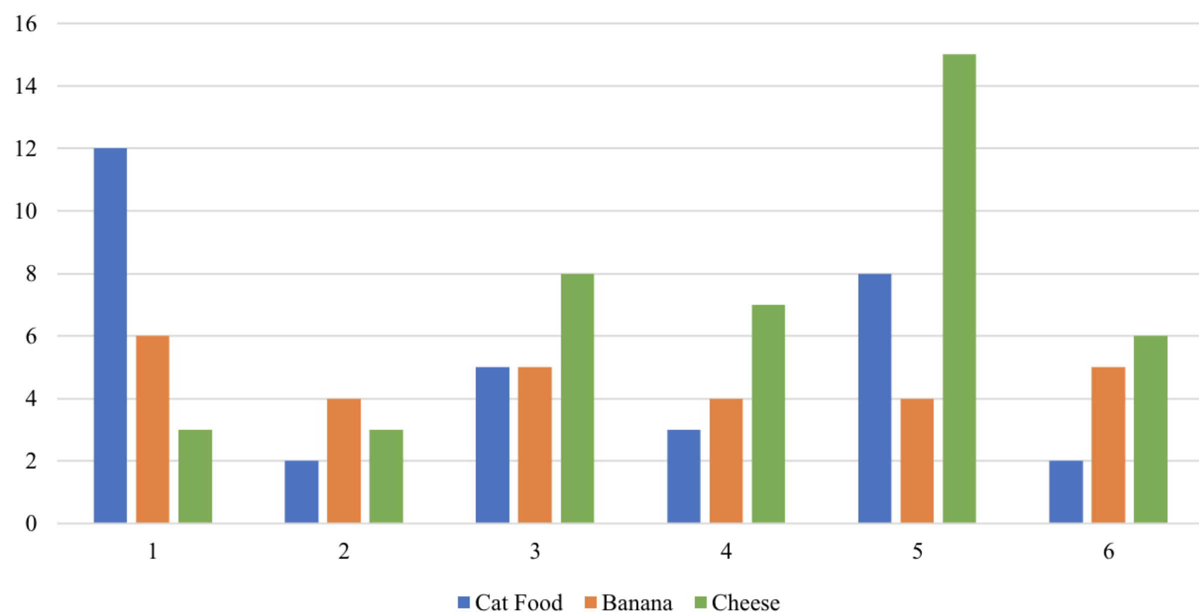


Fig. 2. Number of visits on cat food, banana, or cheese within Population A from six trials (n=180). A Pearson's chi-squared test was used for all the following calculations. Population A had significant visitation rates for trial one ($p \leq 0.050$) and five ($p \leq 0.032$).

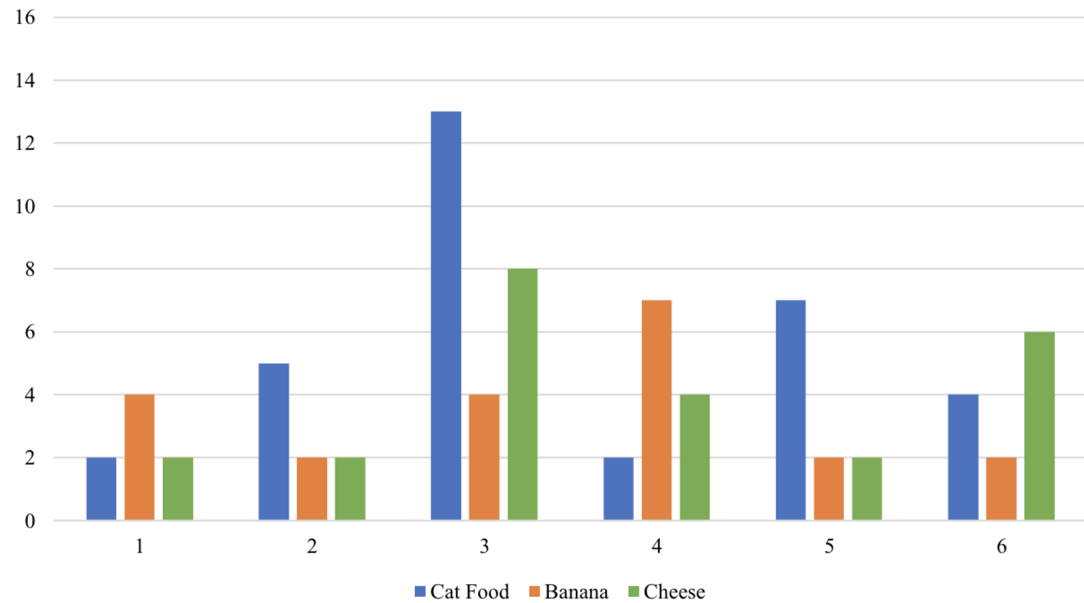

Fig. 3. Number of visits to cat food, banana, or cheese within Population B from six trials (n=180). No significance was derived between the trials ($p \geq 0.050$).

Since the populations were insignificant in their food visitations, data were combined to view the overall visitation values. The cheese was the most visited, cat food second by one count less, and banana third (Fig. 4).

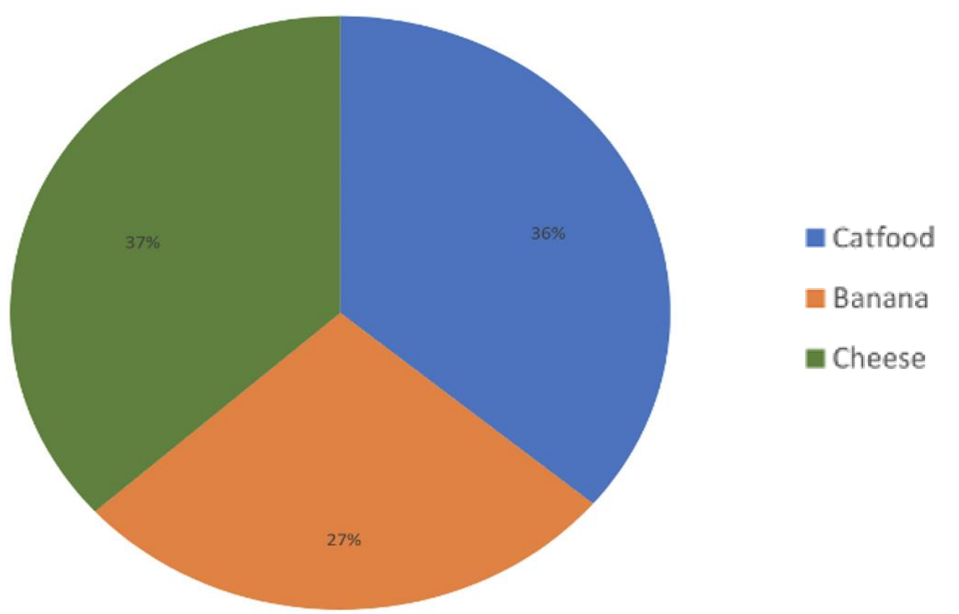

Figure 4. Fig. 4. Comparison of total visitation rates on cat food, banana, and cheese of both populations A and B

**Discussion**

The dubia roach, *B. dubia,* offers easy care, low odor, and a rich protein source that has caused an increase in the use of this insect as a feeder insect for reptile and amphibian pets.

These roaches have the potential as an animal feed ingredient in the insect production industry. The dubia roach's potential as an invasive pest is not well understood, but in increase if knowledge on their diet would be beneficial. It's important to know the food preference, defined here as the number of visits to food, of different life stages of an insect being produced as protein or targeted for pest control baits. This research explored the food preference of young *B. dubia* nymphs.

Adult dubia roaches can regulate their protein-to-carb ratio or amount of food depending on sex and thus choose what they eat (Bouchebti 2022). Adult German cockroaches display similar behavior, with the males choosing primarily carbohydrate rich foods like bananas and potatoes while the females choose carbohydrate-rich and protein-rich foods like peanut butter (Lauprasert 2006). These differences can be attributed to the reproductive needs of each sex, but the nymph must prioritize growth.

This study found no food type that proved significant visits within each population. This could be attributed to the variety of needs that the nymphal stage of a roach requires. Mosayebian found that three or five-day-old *Supella longipalpa* (Blattodea: Ectobiidae) nymphs grew faster on diets that included a mix of macronutrients from dry bread, dry rabbit feed, bran, dates, and water or milk compared to diets only using some of these ingredients, indicating diverse diets are more suitable for growth (Mosayebian 2014).

Insects use volatiles as a sensory or smell information source. Roaches usually respond to smell over short distances, and Lauprasert shed light on potential bias in German cockroach attracted to bananas because of a stronger expulsion of volatiles compared to the other diets used (Lauprasert 2006). To avoid this, the three food types in this experiment were chosen partially based on smell. Despite this knowledge, the visitations on food types were insignificant, as mentioned. However, cat food and cheese were most preferred over bananas for each population separately and in combined total visitation rates. Somewhat similar to these results, Brenner and Patterson observed that brown-banded cockroach, *Periplaneta fuliginosa* (Blattodea: Blattidae), nymphs preferred the protein-rich cat and rat food over distiller grain diets; however, they also found that *Periplaneta americana*, *Supella longipalpa*, and *Eurycotis floridana* (Blattodea: Blattidae) roach nymphs had no significant preferences between the diets (Brenner and Patterson 1989). Similarly, Nalyanya found German cockroach nymphs were overall generalists attracted to the same type of baits that adults were (Nalyanya 2001). Instead of food, it is known that first through fifth instar nymphs are attracted to frass with a diverse microbiome of bacteria (Wada-Katsumata 2015). The inconclusive findings for the nymph food preferences across roach species coincide with the results of this study and could infer that nymphs don't necessarily prefer volatiles or smells from food.

Food behaviors are variable within insect populations of the same species. McPherson compared two laboratory strains reared on identical diets for seven years, and field or apartment strains of B. germanica all consumed different amounts of diet (McPherson 2021). Genetics, gut microbiota, food physicality, maternal diets, environmental conditions, population sex ratio, etc., are all examples of factors that could influence population differences (McPherson 2021, Bouchebti 2022). With this, the chance of two different populations being insignificant is low; however, the populations did not differ significantly in their food choices in this study. This may indicate possible errors within the methods and the experimental design.

Observations of the trials determined that the feeding behavior seemed random, with only two significant preferences for cat food and cheese for trials one and five, respectfully, within Population A. Stanley found that the boldness behavior, examined by the length of time spent hiding after being startled, was consistent and strong through juvenile stages of *Diploptera punctata* (Blattodea: Blaberidae), and adult size and sex changed the boldness, exploratory, and sociality of the roach (Stanley 2017). The trials provided short acclimation times, expecting the nymphs to acclimate quickly and display boldness, but it was also observed that over time, the nymphs would begin to accumulate and huddle in the corners, not paying any attention to the food samples. The personalities or behaviors of animals can be seen on a collective level and can be affected by things like temperature and nutrition (Bouchebti 2022). The temperature during the experiment was maintained around 22.8°C, which is lower than other studies that determined consistent growth of seven instars of *B. dubia* at 30 ± 2°C and 28 ± 2°C (Hintze-Podufal 1986 and Wu 2013). Mishra found that *Gromphadorhina portentosa* (Blattodea: Blaberidae) nymphs were less likely to enact risk acceptance in foraging when raised on a low-nutrition diet (Mishra 2011). The nymphs in this study were without access to food for multiple days, and since they have not had a stable nutrient income for much of their life and the trial conditions were less favorable, it's possible some nymphs were less likely to enact risk acceptance during the trials and thus not visit the samples.

This study concluded that there was no direct relationship between the food preference between a carbohydrate, protein, and fat group from the early nymphal stage of *B. dubia*. Furthermore, the difference in food preference and population origin from the *B. dubia* nymphs was determined insignificant. More research is needed to determine methods to test food preference among young *B. dubia* and further investigate *B. dubia* attraction.

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