



(RESEARCH ARTICLE)



## Domestic pest control of cockroaches (*Periplaneta americana*) by using food-based non-chemical baits.

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### Abstract

The purpose of this experiment was to study the food preference of the household cockroaches (*Periplaneta americana*) in respect of Domestic Pest Control. These collected cockroaches were given choices among nine food items (three carbohydrate-rich foods: banana, bread, potato; three protein-rich foods: crushed peanuts, cottage cheese, walnut and three mixed diet). Modified nine-chambered olfactometers were used for this food preference experiment. Each kind of food was placed in each chamber of olfactometer with 10 cockroaches in each replica were placed in the center of olfactometer. 2 replicas of olfactometer were constructed of same kind. The olfactometers were observed for continuous 5 days i.e. 120 hours. The cockroaches were checked during day and night time each day, the amount of food consumed by them was recorded of each duration and the simple biostatistics mean and standard deviation were used for inferring the food preference of the cockroaches. The results show that the maximum of the cockroaches preferred walnut as compared to other offered baits. Bread was the second most preferred food followed by peanuts, cottage cheese, mixed diet, banana, and potato. Furthermore, the feeding behavior of these cockroaches occurred during the day hours 12:00-4:00 pm and night hours 01:00-04:00 am. The feeding gets of the cockroaches was started by swinging their antenna followed by touching the food baits offered.

**Keywords:** Food preference; Olfactometer; Feeding behavior; Cockroaches; Non-chemical baits.

### 1. Introduction

For most of the insects, nutrition not only affects the survival of adults but also their reproductive output. Generally, female fecundity depends upon the intake of protein which are necessary for egg development whereas male fertility does not depend much on proteins. Moreover, insects generally are not able to convert lipids to monosaccharides by themselves and carbohydrates are one of the nutrients that both sexes use as a primary energy source [1]. Nutritional factors reportedly had deep short-term and long-term effects on the development and reproduction of insects [2]. Even though the nutritional requirements of most insects are relatively similar, the ideal sources, types and proportions of nutrients widely vary among species and reproductive stages [2]. Recent studies revealed that insects visibly show sex-specific differences in feeding behaviors and adult nutritional requirements. For example, young female tephritid fruit flies, *Bactrocera dorsalis*, (Diptera: Tephritidae) are attracted to the smell of protein food baits more than the smell of host fruit [3,6]. Moreover, male Madagascar hissing cockroaches *Gromphadorhina portentosa* (Dictyoptera: Blaberidae) preferred carbohydrates rich foods on the other hand females prefer protein-rich foods [1].

The entomologists have been interested in studying about the food preference and feeding behavior of the cockroaches because they are one of the most common household pests. The range of food substance consumed by cockroaches is more than any other insect [4]. The odorous discharge by American cockroaches can alter the flavor of food. Also, if populations of cockroaches are high, a strong attention of this odorous secretion can be present. Cockroaches can pick up disease-causing bacteria, similar as Salmonella, on their legs and after deposit them on foods and beget food

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poisoning or infection if they walk on the food. House dust containing cockroach feces and body corridor can spark allergic responses and asthma in certain individualities. At least 22 species of pathogenic mortal bacteria, viruses, fungi, and protozoans, as well as five species of helminthic worms, have been insulated from field- collected *P. americana*.

Chemical pest control involves synthetic composites that are manufactured to kill or control these pests. Because of this, the harsh composites used in chemical pest control could occasionally beget detriment to the non-targeted organisms as well. Chemical pest control tends to be harsher to humans and the surroundings. Organic Pest Control cause fewer side effects, but there isn't much awareness about these methods. Insects don't develop a natural resistance to natural adversaries. Natural products are (often) environmentally friendly. Therefore, organic methods of pest control can be termed as best suited methods against cockroaches as compared to chemical repellents.

Bait trapping method by avoiding chemical baits and using organic baits can be used to do so. Different food items rich in carbohydrates, proteins and mixed diet can be offered to cockroaches as an organic bait. These organic baits are easily available in our households and can be used as a natural method for repelling cockroaches. This experiment aims to find a new of applying organic pest control method and evaluating the repellency and controlling properties of aforementioned organic baits against *Periplaneta americana*. This research is expected to be useful in controlling and repelling cockroaches in our households in a more environment friendly manner.

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## 2. Material and methods

The design of the experiment was completely randomized with 3 categories of food-based baits and 2 replicates with 20 cockroaches. The methodology is followed by the experiment performed by Prachumporn Lauprasert, 2006. The purpose of this experiment was to study the different types of food-based bait that can be used for trapping cockroaches for domestic pest control. This method of trapping cockroaches can be used for field collections too. The samples of *Periplaneta americana* (household cockroaches) were purchased from the local market of Lucknow. These cockroaches were kept in a plastic container with minute holes on top of the container for continuous oxygen supply in it. The samples of food-based baits have been collected from the local market of Lucknow itself. They were prepared by keeping in mind that all the categories of food i.e. carbohydrates, proteins and mixed diet have been included so as to record the clear observations and identify the most preferable baits that can be used for trapping cockroaches (Figure 1, and Figure 2).

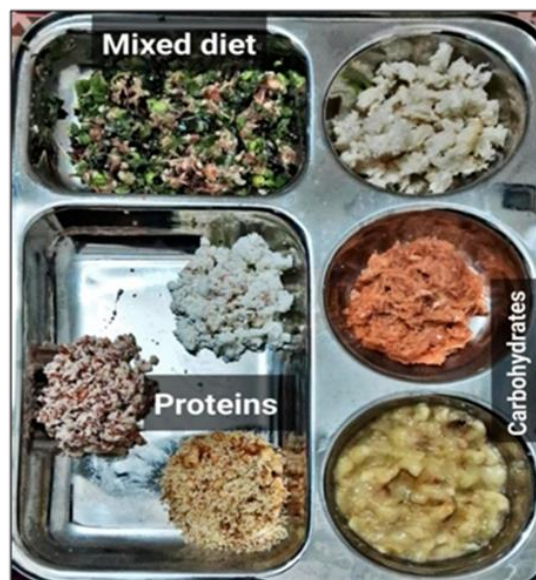
To set up and conduct this experiment a nine-chambered-olfactometer was constructed with the help of rectangular shaped plastic container and boiling tubes (Figure 3). To prepare this instrument, a rectangular plastic container with the dimension of length 20cm, breadth 14cm, and height 8cm is taken and the piercing is made on the 3 sides of the container according to the size of the mouth of the boiling tube with the dimension of length 16cm and breadth 3cm. After the piercing is made the food-based baits prepared earlier were inserted inside the boiling tubes each containing a single food bait. After the food is filled inside the boiling tubes the mouth of the boiling tubes was fixed firmly inside the piercing made. All the tubes were fixed in such a manner that the cockroaches do not escape from the container. After this whole process is completed, the container is covered with its lid. In the same manner, two replicates of the nine-chambered-olfactometer were prepared. Both of these olfactometers were placed on a thermocol base which was made by covering a thermocol sheet with a black paper.

### 2.1. Statistical analysis

The data was projected for statistical analysis to find significant differences between different kinds of food baits offered to cockroaches like banana, bread, potato, peanut, cottage cheese, walnut and mixed diet. The whole calculation is performed with the help of simple calculation methods and the graphs of these calculations are plotted using GraphPad Prism 9 software of Microsoft.



**Figure 1** Cockroaches



**Figure 2** Food based baits



**Figure 3** Olfactometer

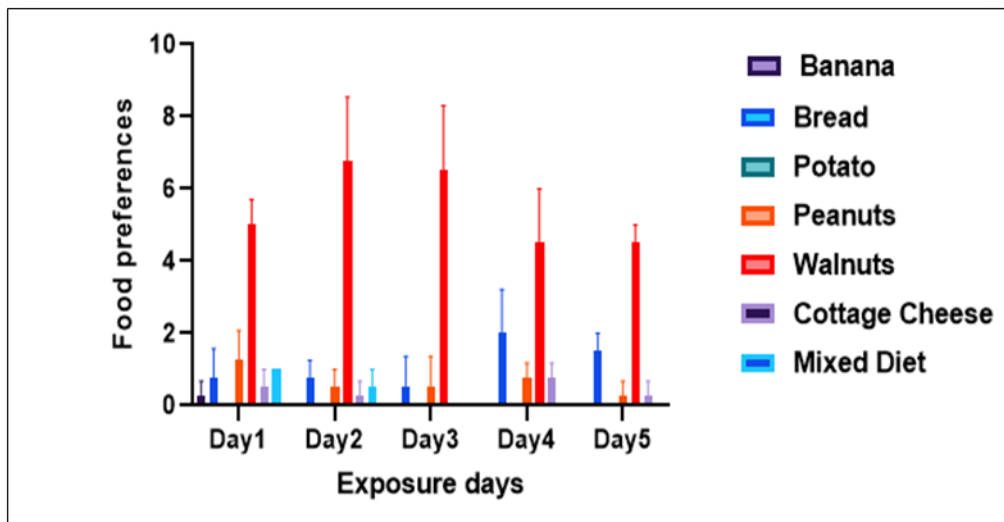
### 3. Results and discussion

The feeding behavior of cockroaches was calculated during the day and night for 5 continuous days. The feeding behavior was observed as the cockroaches move towards the offered food baits of their choice. The trapping of cockroaches was evaluated by keeping the count of the number of cockroaches entering inside the tubes containing food baits. All these data were recorded with their respective timings. During the night time, the feeding behavior shown by the cockroaches was at peak (Table-1, Graph 1 and 2).

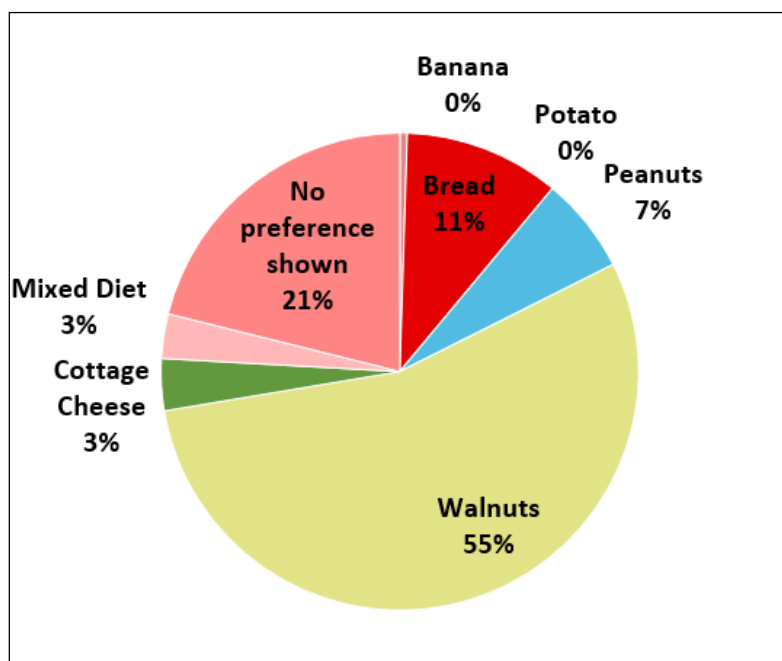
**Table 1** Food preferences of *Periplaneta americana* on Different Day

S.no	Food Items	N	Food Preferences (Mean and Standard Deviation)									
			DAY-1		DAY-2		DAY-3		DAY-4		DAY-5	
			M	SD	M	SD	M	SD	M	SD	M	SD
1.	BANANA	20	0.25	0.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.	BREAD	20	0.75	0.82	0.75	0.50	0.50	0.86	2.00	1.22	1.50	0.50
3.	POTATO	20	0	0	0	0	0	0	0	0	0	0
4.	PEANUTS	20	1.25	0.82	0.50	0.50	0.50	0.86	0.75	0.43	0.25	0.43
5.	WALNUTS	20	5.00	0.70	6.75	1.78	6.50	1.80	4.50	1.50	4.50	0.50
6.	COTTAGE CHEESE	20	0.50	0.50	0.25	0.43	0.00	0.00	0.75	0.43	0.25	0.43
7.	MIXED DIET	20	1.0	0.0	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0

\* N= Number of insects



**Graph 1** Food preference of *Periplaneta americana* on different days



**Graph 2** Percentage of food preferred by *Periplaneta americana*

The results of the applications show the attraction of cockroaches towards the food baits offered to them during the experiment. The results of the experiment clearly show the food preference of the cockroaches towards the offered baits. After the experiment is over while evaluating the results, it was found that the cockroaches preferred walnuts more than the any other food baits offered. Second most preferred food bait was bread and rest were the less preferred food baits.

To calculate these results, simple biostatistics i.e. mean and standard deviation was applied on the data that was collected during the observation period. As per the pie chart prepared on the collected data it was found that the walnuts (55%) were the most preferred food baits followed by bread (11%), peanuts (7%), cottage cheese (3%) and mixed diet (3%). Banana and potato were remained untouched with 0% preference level. Rest 21% of the cockroaches have not shown any food preference. By comparing all the results, it was found that the walnuts can be the most appropriate food based non chemical baits followed by bread to trap the cockroaches (Graph 1-2).

The results of this study showed the highest percentage of food preference among the offered food baits. The results clarify that the walnuts have been the most preferred food baits with 55% preference given by cockroaches followed by bread (11%), peanuts (7%), cottage cheese (3%) and mixed diet (3%). Moreover, under conditions of complete inanition, the cockroaches will eat nearly any food substance that they encounter, unless deprived for a set period of time [5]. From our observation, when we placed them in the center of the olfactometers, they walked directly to the nearest food and fed on it. Their behavior corresponded with other insects which did not respond to monotonous odors as vigorously as when they are very hungry [5]. After the cockroaches are full, they hid near the borders of the chambers of olfactometer. Then, they survived on the foods in all the chambers of the olfactometer before the food were chosen.

Our results clearly shows that cockroaches prefer protein rich food more than the carbohydrates or any other food bait. We believe that the cockroaches preferred walnuts due to its nutritional value and richness in protein. Most of the cockroaches preferred walnuts more than the bread or any other baits. Only small number preferred bread or any other baits. Besides the nutritional factors, the odors and textures of foods are also important. Cockroaches often respond to food odors over short distances [5]. The texture of walnuts is soft and fine. Thus, the walnuts attracted the ravenous cockroaches. In contrast the texture of bread is bit harder, and the cockroaches might be aroused and attracted by soft and fine foods which are easy to eat under stress condition such as starvation. The cockroaches feeding behavior were at peak during the day 12:00-4:00 pm and during the night hours 1:00-4:00 am. For the feeding behavior the cockroaches are nocturnal insects [2]. In a similar experiment, (Prachumporn Lauprasert et al.,2006)[7] found that the cockroaches were more attractant to the soft and fine foods as compared to rigid ones. In this experiment the female cockroaches were more attracted to the protein rich foods as compared to any other food bait. Whereas he also profound that the feeding behavior and food preference of the cockroaches that is clearly shown in this experiment too. Firstly, the cockroach left the shelter and swung its antenna to detect food odor by chemoreceptors which are located on the

antenna [6]. The above results and discussion show the food preference and non-chemical food baits that can be opted to perform the trapping of the cockroaches whereas still there is more research required on the food preference, feeding behavior and the non-chemical baits for *Periplaneta americana*.

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#### 4. Conclusion

It is concluded that the protein rich food such as walnuts with strong odor and the carbohydrate rich food i.e. bread can be used as a suitable and effective food-based baits while trapping the cockroaches. Usually, the chemical and synthetic pesticides used in the most of the households found to be hazardous to human health and lives. They cause severe serious diseases and can harm us in multiple of ways. Therefore, to overcome the problem and risks of using these chemical insecticides the non-chemical food-based baits can be used for trapping the cockroaches. Cockroach trapping with these baits could be used for the domestic pest control in the households. This method of trapping cockroaches could also be used for field trapping.

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#### Compliance with ethical standards

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##### *Disclosure of conflict of interest*

The authors have no any conflict of interest for publishing this article.

##### *Statement of informed consent*

Informed consent was obtained from all individual participants included in the study

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#### References

- [1] Carrel, J. and Tanner, E. (2002) "Sex-specific food preferences in the Madagascar Hissing Cockroach" *Gromphadorhina portentosa*. *Journal of Insect Behavior* 15(5), 707-714.
- [2] Cooper, A. and Schal, C. (1992) "Differential development and reproduction of the German cockroach (Dictyoptera: Blattellidae) on three laboratory diets" *Journal of Economic Entomology*. 85(3), 838-844.
- [3] Cornelius, M., Nergel, L., Duan, J. and Messing, R. (2000) "Responses of female oriental fruit flies (Diptera: Tephritidae) to protein and host fruit odors in field cage and open field tests" *Environmental Entomology*. 29, 14-19.
- [4] Jones, A. and Raubenheimer, D. (2001) "Nutritional regulation in nymphs of the German cockroach, *Blattella germanica*." *Journal of Insect Physiology*. 47, 1169-1180.
- [5] Reiersen, D. (1995) Baits for German cockroach control in: Rust, M., Owens, J., Reiersen, D. (Eds.) *Understanding and controlling the German cockroach*. Oxford University Press, Oxford. 430 pp.
- [6] Ross, H. and Mullins E. (1995) *Biology In: Rust, M., Owens, J., Reiersen, D. (Eds.) "Understanding and controlling the German cockroach*. Oxford University Press, Oxford. 430 pp.
- [7] Prachumporn Lauprasert, Duangkhae Sitticharoenchai, Kumthorn Thirakhupt and Artong pradatsudarasar (2006) "Food Preference and Feeding Behavior of the German Cockroach, *Blattella germanica* (Linnaeus)" *Pradatsudarasar* 122 *J. Sci. Res. Chula. Univ.*, Vol. 31, No. 2 (2006).