International Journal of Entomology Research
ISSN: 2455-4758; Impact Factor: RJIF 5.24
www.entomologyjournals.com
Volume 1; Issue 5; July 2016; Page No. 09-11

Food coated with coffee as an attractant towards household ants, (*M. pharaonis* L.) and (*T. melanocephalum* F): Analysis of feeding preference for ants bio-control and management

[1]Abdul Hafiz Ab Majid, [1] Wan Ahmad Syahir Wan Umar, [1] Siti Salbiah Ellias, [2] Hamady Dieng

[*1] Household & Structural Urban Entomology Laboratory, School of Biological Sciences, Universiti Sains Malaysia, Malaysia
[2] Institute of Biodiversity and Environmental Conservation, Universiti Malaysia Sarawak, Kota Samarahan, Sarawak, Malaysia
*Corresponding author: abdhafiz@usm.my

Abstract
Ants considered as pest when they invade buildings in search for food and water. The most common method in controlling household ant infestation is by spraying an insecticide. Food preferences of *Monomorium pharaonis* and *Tapinoma melanocephala* towards four different types of food (tuna, peanut butter, cricket and egg) coated with 3 different concentrations (1.5g, 4.7g, and 9.4g) of two types of coffee (pure and roasted) were evaluated. *M. pharaonis* does not affected by the nature of the foods as coated coffee foods and normal foods do not vary in term of attraction of the Pharaoh ants. In contrast, *T. melanocephalum* preferred tuna coated with pure coffee at medium concentration 4.7g. Pure coffee coated tuna also can be used as a bait attractant against *T. melanocephalum*. Thus, coffee can be used as one of biological agent to control household ant's infestations.

Keywords: Household ants, coffee, bio-control, food preference

1. Introduction
Ants are insects belonging to the family Formicidae, under the order of Hymenoptera. Its distinguished character is having slender waist part and living in the social community. It's have elbowed antennae, metapleural glands and a strong constriction of their second abdominal segment into node-like petiole. Ants can be identified using various characters based on the pilosity (body hairs), sculpturing (of body surface), shapes and location (of body parts) [1]. Some ant species may only live within the building compound, some may live outdoors and some may live both [1, 2].
Ants generally prefer three types of food. There are carbohydrate, protein and oil based [2, 3]. Different stages of ants prefer different kinds of food where carbohydrate and protein are rapidly distributed among all larval stages where lipid (oil) transferred only after a period of starvation [4].
Coffee plant is believed to be originated in Africa and Madagascar [5]. Around more than 70 species of *Coffea* spp can be found widespread throughout the tropic region which all of them originated from Africa land [6]. Ethiopian Highlands and region near the Red Sea, in Yemen are the first places reported where the cultivation process take places. Coffee from genus *Coffea* has been established as commercial coffee [5, 6]. *Coffea arabica* has been proved genetically same with the genetic diversity of coffee plantations of same genus in the highlands of South-Western Ethiopia and Boma Plateau of Sudan [7].
Coffee has been widely explored for its potential as biological agents to control insect pest. For example, the development of *Aedes aegypti* in the larval stage can be blocked by caffeine thus inhibit them from developing into adults [8]. In that experiment, the fecundity of the female tend decrease where it is observed in term of egg laid per female over generations at 200 and 500 ug/mL of caffeine concentration. The productivity of adults begins at initial number 200 eggs for each generations show different range of productivity where for control ranging from 11%-63.5% while for treated, 3.2%-52% [8]. Same concept of experiment also has been carried out using coffee ground (UCG) suspensions in suitable concentration will blocked the development of the mosquito thus manage to stop spreading of viruses as adult cannot be formed. About 50 or 100 mg/ml of UCG is enough to block the development of the mosquito in the larval stage [9]. According to Eastrep [10], stated that mosquito reared in control (water) tend to pupate slower than mosquito reared in coffee.
The purpose of this research, to examine food preferences of *Monomorium pharaonis* and *Tapinoma melanocephala* towards four different types of food (tuna, peanut butter, cricket and egg) coated with 3 different concentrations (1.5g, 4.7g, and 9.4g in 150 mL of water) of two types of coffee (pure and roasted).

2. Materials and Methods
Preparation of experimental coffee substrates
There were two types of coffee; pure and roasted. The roasted coffee was in the powder form while the pure coffee was in seed form. The seeds of the pure coffee was grinded using blender (Pensonic Blender PEN-PB3103; Senheng® Electric Sdn. Bhd., Kuala Lumpur, Malaysia) for 10 minutes. Amounts of 1.5g, (low) 4.7g (medium) and 9.4g (high) were used for both coffee types. All coffee powder was kept in the oven to avoid alteration or contamination.

Preferences of ants towards coffee coated food
Four types of food were used in this experiment. They were tuna, cricket, peanut butter and egg yolk. All of this food was coated with pure coffee and roasted coffee. Each of the coffee has three different concentrations, 1.5g, 4.7g, and 9.4g in 150 ml of water which represent low, medium and high respectively (Table 1). The food was wrapped in filter paper

and wrapped again in a piece of cloth. All types of food were bathed in the solutions and left in the oven for 10 hours for it to dry. The oven was set at 80°C. When the food was dry, the food was weighed at specified weight to use in bio-assays. The weight of the food was recorded before and after the experiment. Five Ideal Care® sample containers were used in this experiment and each of the Ideal Care® sample container was connected to the 6.4mm x 0.75mm plastic tube. One container was at the center and surrounded by the other four containers. Each of the containers held one of the following food type: peanut butter, egg yolk, cricket and tuna. The container at the center was the place where 55 ants were released. Each of the experiment had 4 replicates with one control. For the control, the normal food was used (same type of foods, but with no coated coffee) was also bathed in 150ml of distilled water. The data of the experiment were recorded in every 30 minutes for the first three hours, 6th hours, 12th hours and 24th hours. After 24 hours, the data were recorded once, until day 4 at zero hour of the experiment.

Analysis of the data

Preferences of coffee coated food for both ant's species were analyzed using one-way ANOVA that significant at $P < 0.05$. For the final part, both of the ANOVA and independent samples t-test were used to determine the significant value of subject matters.

3. Results

There was no statistically significant difference as shown by one-way ANOVA (F (29, 66) = 1.074, $P > 0.05$). A Tukey post-hoc test revealed that there were no significant differences of food preferences in *M. pharaonis* either for coffee coated food or non-coated food at level $P > 0.05$. Thus, ants moved to the preferred food not affected by coffee (Figure 1).

Table 1: Coffee with different concentrations

Food bathed in different concentration (in g per 150mL)	Types of coffee	
	Pure	Roasted
1.5 (low)	✓	✓
4.7 (medium)	✓	✓
9.4 (high)	✓	✓

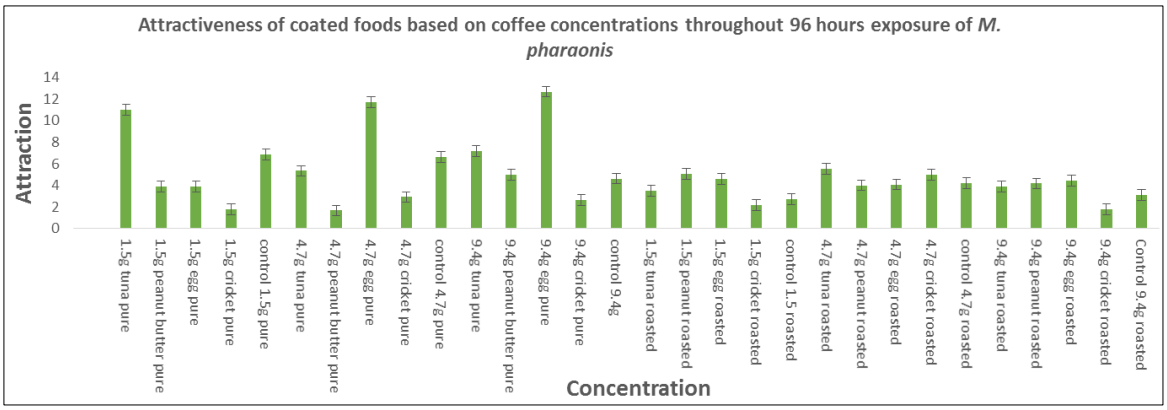

Fig 1: Attractiveness of coated and normal food preferences of *M. pharaonis*

There was statistically significant difference between groups as determined by one-way ANOVA (F (29, 66) = 3.927, p = 0.000). A Tukey post-hoc test revealed that there was significant difference in *T. melanocephalum* between the coated coffee foods and normal food as simplified. From the result, 4.7g pure coffee coated tuna attracts the ants most compared to other foods (Figure 2)

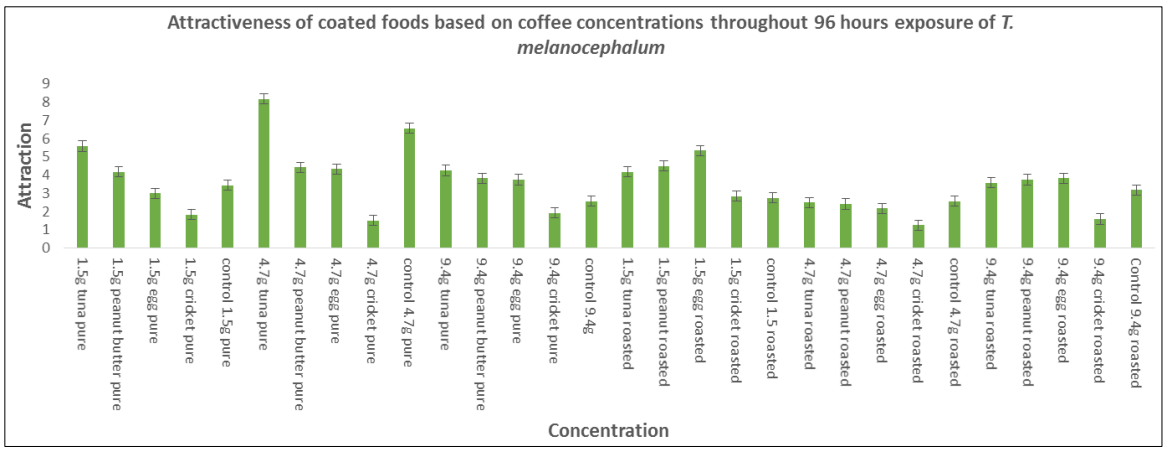

Fig 2: Attractiveness of coated and normal food preferences of *T. melanocephalum*

4. Discussion

From the results, both ant's species show no significant difference in food preferences between the foods coated with coffee (pure coated and roasted coated) and normal foods (foods that have no add on). Thus, both types of coffee do not have any effect to the ant preferences in choosing type of foods. The foods maybe selected based on their needs at a particular time [4, 11]. In addition, the method used to coated the foods may be not very successful, thus no difference of preferences were observed between the foods coated with coffee and non-coated foods with coffee. However, by comparing the means between the foods, 1.5g pure coated tuna, 4.7g pure coated egg and 9.4g pure coated egg were among the foods that preferred by the ants. When we observed this kind of foods, it's rich in protein as similar to the peanut butter used inside ants trapping tube as bait [4, 11]. *T. melanocephalum* shows significantly different between the coated coffee foods and non-coated coffee food, but this applied to certain foods with certain concentration of coffee and type of coffee used. In this part of the experiment, 4.7g pure coffee coated tuna attracts the most. While 1.5g pure coffee coated tuna attracts the least, but the similarity here, the ants preferred tuna as their food coated with pure coffee. Thus, pure coffee that coated the tuna enhance the attraction of ants towards tuna. However, no significant difference was observed in 9.4g pure coated tuna and 4.7g pure coated tuna for *T. melanocephalum*. Perhaps, the higher concentration used in this experiment had deter the ants away from the 9.4g pure coated tuna and same goes for the roasted coffee coated food. Form the experiment, higher concentration and roasted coffee do have higher caffeine compared to lower concentration and pure coffee respectively [8,9,12]. *M. pharaonis* do not affected by the condition of the foods as it reacts in the same way for coated and non-coated coffee foods. In contrast, *T. melanocephalum* attracted towards pure coffee coated with tuna. The methods of coating the foods with coffee should be improved as the different in responses of both ants towards coated coffee foods may lies within the coating process. Thus, coffee have the possibility to be used as one of the ingredients for ant's baits that could aid in new alternatives on controlling the ant pest population instead of using chemicals.

5. Acknowledgement

The authors would like to acknowledge Ministry of Higher Education (MOHE) funding the research under Fundamental Research Grant (FRGS) (FRGS: 203 / PBIOLOGI / 6711360).

6. References

1. Holldobler B, Wilson E. The Ant: Belknap Press, 1990; 1-746.
2. Annie GH, Lee CY. Comparative nutritional preferences of tropical pest ants, *Monomorium pharaonis*, *Monomorium floricola* and *Monomorium destructor* (Hymenoptera: Formicidae). Sociobiology 2007; 49(3):165-186.
3. Eow AG, Chong AS, Lee CY. Effects of nutritional starvation and satiation on feeding responses of tropical pest ants, *Monomorium spp*. (Hymenoptera: Formicidae). Sociobiology. 2005; 45(1):15-30.
4. Chong A, Chong NL, Yap HH, Lee CY. Effects of starvation on nutrient distribution in the Pharaoh ant, *Monomorium pharaonis* (Hymenoptera: Formicidae) workers and various larval stages. In Proceedings of the Fourth International Conference on Urban Pests. Pocahontas Press, Inc. Blacksburg, Virginia, USA, 2002, 121-127.
5. Oestreich JS. Chemistry of coffee. Chemistry & Biology 2010; 3:1085-1117.
6. Pohlan HAJ, Janssens MJJ. Growth and production of coffee. Soils, Plant Growth and Crop Production. In Encyclopedia of Life Support Systems (EOLSS) 2010, 3.
7. Lashermes P, Combes MC, Robert J, Trouslot P, D'Hont A, Anthony F, *et al.* Molecular characterization and origin of the *Coffea arabica* L. genome. Molecular and General Genetics. 1999; 261(2):259-266.
8. Laranja AT, Manzato AJ, Bicudo HE. Caffeine effect on mortality and oviposition in successive generations of *Aedes aegypti*. Revista de Saúde Pública 2006; 40(6):1112-1117.
9. Guirado MM, Bicudo HE. Effect of used coffee grounds on larval mortality of Aedes aegypti L. (Diptera: Culicidae): suspension concentration and age versus efficacy. Rev Bio Assay, 2007; 2:1-7.
10. Eastep NE, Albert RE, Anderson JR. Modulation of La Crosse virus infection in *Aedes albopictus* mosquitoes following larval exposure to coffee extracts. Frontiers in Physiology 2012; 3.
11. Lee CY. Tropical household ants: pest status, species diversity, foraging behavior and baiting studies. Proceeding of the 4th International Conference on Urban Pests, 2002; 3-18.
12. Mehmet O. How much caffeine is in green coffee bean supplements? 2014. from http://www.sharecare.com/health/dietary-supplements/how-much-caffeine-green-coffee-bean. Retrieved 1 July, 2014.