The effect of some food sources and hive products on the oriental hornet *Vespa orientalis* Linnaeus 1771 (Hymenoptera: Vespidae)

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Abstract

This study was carried out in the bee laboratory in the Faculty of Agriculture –University of Kufa in September 2021 to evaluate some protein sources and hive products against the oriental hornet *Vespa orientalis* Linnaeus 1771 (Hymenoptera: Vespidae). The food sources included: beef meat, gut fish, beef lung, honeybee, wax, propolis, pollen, bee worker, and water, in addition to control which was an empty petri dish. The number of visits and their duration were calculated. The results showed that the wasps preferred bee honey and wax significantly higher than the rest of the stimuli.

Keywords: Food sources, Hive products, Honeybee, *Vespa orientalis*, Vespidae

Introduction

The oriental hornet *Vespa orientalis* Linnaeus 1771is a social insect that belongs to the subfamily Vespinae (Vespidae: Hymenoptera) which consider true hornets, they consist of a caste system dominated by a queen, in addition to the presence of workers and drones. Their nests are built underground and consist of multiple combs (6).

This species is one of the most important pests that cause damage to honeybee queens, workers, and males in addition to the brood as well as their products like honey and royal jelly (2). The percentage of the destroyed bee colonies during the wasp's active season was 45.19 and 35.29% during 2007 and 2008 respectively in Giza (1 and 7) found that the oriental wasps increase during July, August, and September and they attack the grapes, peach, dates, and figs. Kareem(8) mentioned in a study conducted in the middle of Iraq, specifically in Najaf, Karbala, Al-Qadsiyah, and Wasit provinces during the years 2009, 2010, and 2011, that the death rate of honeybee hives caused by the oriental wasps was 30.9, 24.89, 23.1, and 22.64% in Wasit, Najaf, then Karbala, and finally Al-Qadisiyah, respectively.

In a study conducted in Egypt to attract oriental wasps to traps using various attractants, the bee honey solution was the most effective, capturing 66.5 workers per week, while tuna captured 36 workers per week (14). In a study carried out in Dohuk province, north of Iraq, to evaluate the efficacy of four types of baits included: Tuna fish, meat, sheep lung, and chicken meal; the result showed that the fish bait was the highest attractant with 67.75 insects/bait (3).

This study aimed to evaluate the efficiency of some protein materials and hive products in attracting oriental wasps *V. orientalis* under laboratory conditions.

Materials and Methods

Specimens' collection and caging procedures

Vespa orientalis workers were collected individually by aerial net with a wood handle at the Faculty of Agriculture – University of Kufa, Najaf Province (N 32.11248^0 E 44.36931). The insects were brought to the Bee laboratory and put in the cubic cage (60*60*60 cm, fig.1A). The front part of the cage was equipped with mesh sleeves to insert the hornets into the cage, and the basement of the cage contains a moveable drawer (Fig.1B) with an aluminum plate to deliver the stimuli into the cage safely. A camcorder was placed at the top of the cage to record the wasp's behavior during the experiment, the cage was well lighted with red light, which allowed filming of the hornets while preventing their use of the visual cues during the test (12). Ten different stimuli were used (85 mg for each stimulus): Bee honey, bee wax, and pollen were obtained from a local beekeeper, bee worker, obtained from the apiary of the Faculty of Agriculture, the lung of beef, beef meet. Fish guts, wet paper, and control (an empty dish).

The stimuli were individually put into the Petri dishes (35 mm) and delivered into the cage with the movable drawer.

The treatments were put in the box randomly using a research randomizer (https://www.randomizer.org), before each session the movable drawer was washed with ethanol 70% to remove any stimulus residues. To observe the behavior of wasps toward the stimuli, the drawer area was recorded with a mobile phone camera (I phone 7 plus, recording video at 1080 p at 30 fps) for 15 minutes. The experiment was repeated 8 times with different groups of wasps, and new stimuli were used for each trial. Temperature and humidity were recorded during the experiment. At each time a wasp entered a petri dish – at least with insert its head- entry and exit times were recorded. Wasp attraction to the different food and hive production was measured as two variables: 1- visit number: Total number of wasps visiting stimuli in each session, 2: visit duration: the total duration of each wasp visits to the stimuli during the session.

The statistical analysis was carried out according to a complete randomized design (CRD) using GenStat software and the means were compared using the least significant difference (L.S.D) at 5%.

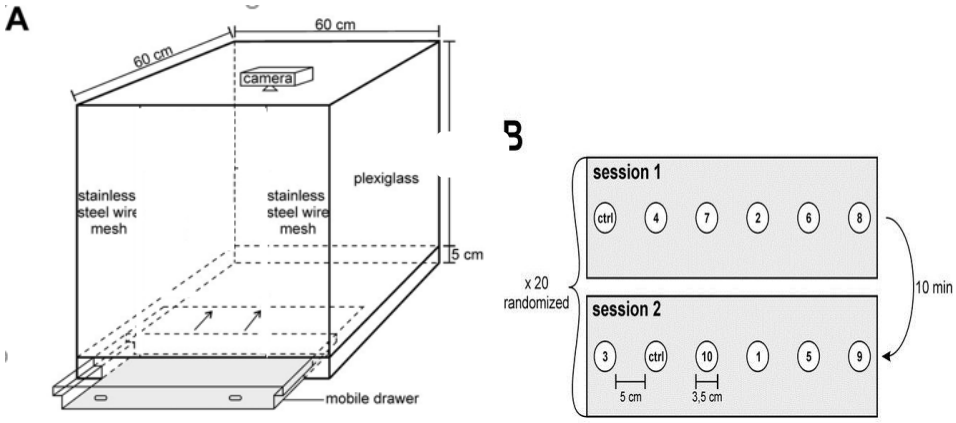

Figure 1. Experimental cage. A. Schematic drawing of the cubic wooden cage (60*60*60) used for experiments. B. The Mobil drawer (11)

Results

The behavior of 80 wasps in the 8 experimental trials aimed to test their olfactory attraction towards the food sources, the present results showed that the wasps could explore the cage drawer containing 10 Petri dishes supplied with food as well as control. Thus, the exploration behavior of wasps can be assessed by their visits to stimuli and the control.

Food attraction:

The results showed that the bee honey and wax were more attractive to wasps than other stimuli where the numbers of visits were 4.9 and 4.14 respectively compared to 0.29 in the control, while the other stimuli were not given a significantly different the number of visits which were 1.57, 0.86, 1.710.57, 1.43, 1.86 and 0.29 for the bee workers, propolis, water, pollen, lung, meat, and fish compared with 0.29 in control.

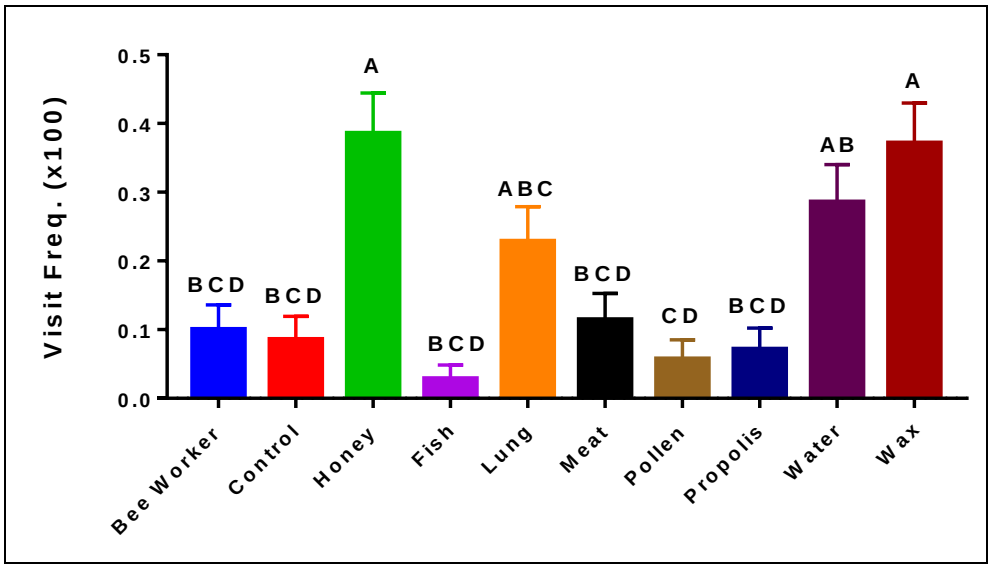

Figure 2. Wasp attraction toward some foods and hive products, the number of visits to each food source for 15 minutes =8. L.S.D 0.05= 2.091

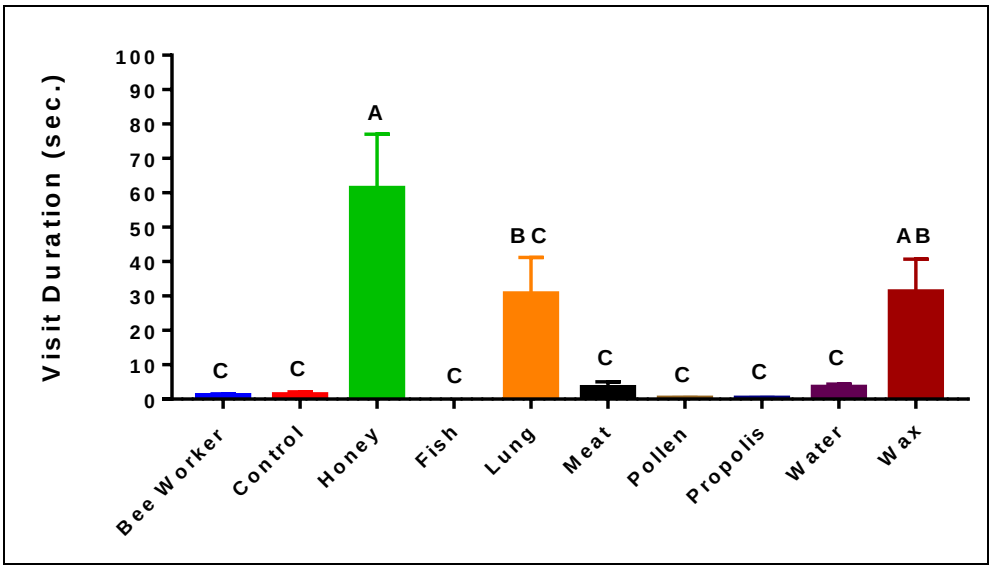

Figure 3. Duration of food visit to each food source for 15 minutes=8. L.S.D 0.05= 53.03

The duration of the food visit

The study results showed that the wasps spent more time in bee honey and wax where they reached 195.65 and 63.24 sec. respectively. While the duration of food visits was 9.88, 2.29, 4.31, 1, 31.31, 15.6, and 0.43 sec. in bee workers, propolis, water, pollen, lung meat, and fish respectively compared to 0.29 sec. in the control.

Discussion

To the author's best knowledge, previous studies revealed that wasps use both visual and olfactory cues to determine food sources (15). So, we aimed in this study to evaluate wasp's olfactory attraction by avoiding visual cues to locate food via darkening the cage and leaving low-level red light as Hymenopteran lacked red receptors (4). This will facilitate recording

the behavior videos. Thus, the visual cues were little or absent, and to avoid any possible bias of the specimens towards the red light. The food sources were placed randomly in each session; therefore, we made sure that the wasp's behavior in the experiment resulted from olfactory cues, not visual cues. In our experiments, *V. orientalis* wasps showed an interest in the hive products rather than the bees themselves, and this also has been noticed by Clapperton *et al*. (5) who found that *V. velutina* wasps attracted to the hive products more than protein resources. Previous studies have found that cues associated with their prey but not directly coming from the prey influence the foraging behavior of some parasitic wasps (11) and social wasps like *Mischocycattrus flavitarsis* take olfactory cues from the plant that has injured by the feeding activity its prey (9). Our results are supported by the study of Sweelam *et al*. (14) who found that fermented sugar syrup and bee honey attracted oriental hornet queens and workers in the field, and agree with Mazeed *et al.* (9) which concluded that the trap with bee honey and syrup were the best way to control the hornet *V. orientalis*

Oriental wasps collected protein (10) to feed their larvae, but they also need carbohydrates to survive, where workers collect many sweet materials such as palm date, figs, and grapes (1).

According to Clapperton *et al*. (5) and Peitsch *et al*. (13) the wasps attack foraging worker bees at the hive entrance and causing weak colonies and lower of their productivity.

Conflict of Interest

The authors have no conflict of interest.

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