Food Fight!

The Effects of Octopamine on Resource Competition in Crickets

J. Leonard and B. Susko **Reed College Bio342**

Researchers have observed aggressive competition for resources in isolated and starved crickets. In these competitions, the initial possessor of the food pellet usually wins [1]. Octopanmine, a neurotransmitter similar to adrenaline, increases aggressive tendencies in crickets [2].

Do octopamine injections increase aggressive behavior during resource competition? Will non-possessors be able to out-compete possessors under these conditions?

Treatment types:

OP: Octopamine injected possessors

ON: Octopamine injected non-possessors

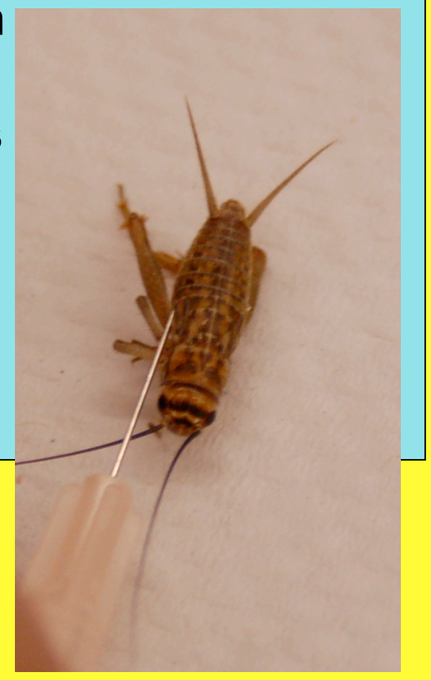
RP: Ringer injected possessor

RN: Ringer injected non-possessor

***Hypothesis*:**
Octopamine will increase aggression and allow ON crickets to gain possession of food from RP crickets and OP crickets will remain in control against RN. In competitions between crickets of the same treatment (OP vs. ON, RP vs. RN), possessors are expected to win.

***Experimental Design*:**
Crickets were isolated and starved for between 42 to 72 hours before injection and competition. Crickets were anesthetized with CO_2 then injected with either 10% ringer solution (blank) or Octopamine (10^{-2}M) and allowed to recuperate for about an hour. One cricket was allowed to become acclimated to a food source for five minutes (this constitutes "possession") before the other cricket was introduced to the testing arena. The pair was observed for five minutes and a winner was determined by scoring the frequency of food consumption. To see if the octopamine was actually getting to the brain, several crickets were injected with methylene blue (0.05% w/v) and dissected them.

Dissection of cricket injected with methylene blue



Typical cricket injection

Results:

Of the eleven trials performed, only four had a determinable winner. In most trials, crickets ignored each other and the food. In the four trials that had a winner, three of the winners were possessors which supports previous findings that possessors remain in possession. There were no conclusive results indicating the effect of injection treatment.

Gassed and octopamine injected crickets had a higher mortality rate and had major physiological problems. Many exhibited dragging antennae and abnormal motor function that prohibited them from righting themselves when flipped over. These effects reduced the viability of the experiments.

Cricket testing arena. Both crickets are ignoring each other and the food (top center).

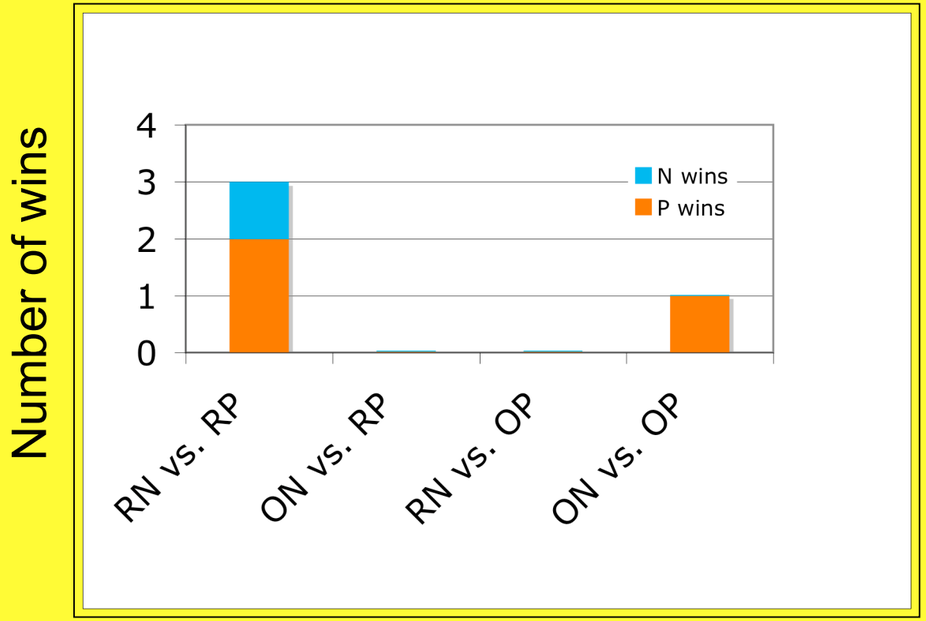


Figure 1: Number of for possessors and non-possessor in varying treatment trials. N=11

Octopamine injected cricket (left) with drooping antennae beside ringer injected cricket (right) with upright antennae.

Conclusions:

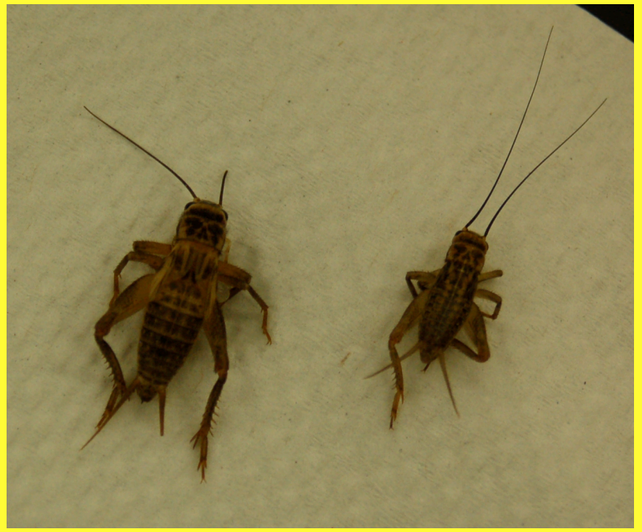
These results support the results of other literature by showing that possessors are more likely to remain in possession of the food than non-possessors. The effects of octopamine on crickets are very case specific which differs from the uniform reaction to the ringer solution.

Future Directions:

The trials conducted show that octopamine had an adverse effect on the crickets. The possible reasons for the negative effects could be attributed to:

- **overdose**
- **the crickets might have been too small**
- **CO_2 may be interacting with the octopamine**

Further experiments could be conducted testing the threshold level of octopamine in crickets and what happens when crickets overdose. From the blue dye injection, it can't be certain that the octopamine is getting all the way to the brain. If the octopamine isn't getting to the brain how and why are negative side effects observed in the crickets?



Typical crickets used in experiment (right) beside petstore crickets (left, not used in experiment)

References

1. Nosil P (2002). Food Fights in House Crickets, *Achetas domesticus*, and the Effects of Body Size and Hunger Level. Canadian Journal of Zoology.

2. Matsumoto Y, Sakai M (2001). Brain Control of Mating Behavior in the Male Cricket *Gryllus bimaculatus* DeGeer: Excitatory Control of Copulatory Actions. Zoological Science 18:659-669.

3. Minnesota Pollution Control Agency. (2005). Electronic document, http://www.pca.state.mn.us/kids/c-september.html, accessed November 29.

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