Abdominal ‘Secretory’ Organs and their Biological Functions in a Spartaeine Genus of Jumping Spiders, *Portia* (Araneae: Salticidae)

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ABSTRACT

Many female spiders are known to emit sex pheromones from their cuticle and/or silk. Little else is known about other sites of sex pheromone dispersion. In some primitive jumping spiders, fields of abdominal ‘secretory’ organs have been observed. It has been hypothesized that they may be sites of sex pheromone emission. In this study, these organs were re-examined in *Portia labiata* and *P. fimbriata* and the hypothesis was investigated through behavioural experiments. Results showed that fewer males were attracted to females with their abdominal ‘secretory’ organs covered. This implies that the organs are sites of sex pheromone production. Greater reliance on pheromones may be considered plesiomorphic in these visual animals and the study of these organs might be important in phylogenetics. Structurally similar organs were discovered on the legs as well.

INTRODUCTION

Jumping spiders (Salticidae) have excellent eyesight and visual signals often suffice in stimulating male courtship behaviour. As such, salticids might be expected to use pheromones in only a minor way. Despite this notion, contact pheromones in draglines are very common in salticids and typically elicit male courtship behaviour (Gaskett, 2007). Besides silk and cuticular pheromones, little else is known about other sites of pheromone production.

Abdominal ‘secretory’ organs that have a mytiliform appearance were observed in a primitive subfamily of salticids, the Spartaeinae (Wanless, 1984b). It was hypothesized that these could be sites of pheromone production. Notwithstanding this interesting and potentially insightful observation, studies have not been conducted to investigate this hypothesis.

Greater pheromonal activity might reasonably be viewed as a primitive trait in the visually acute salticids. Although *Portia* is a genus of the primitive Spartaeinae subfamily, a remarkable case of convergent evolution of eye ultrastructure in the genus and higher salticids was observed (Su et al., 2007). Through examining the function of these organs in *Portia*, new insight may be gained into understanding the relationship between the dependence on pheromonal and visual cues during

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courtship, since Portia may be deemed as visually ‘advanced’ primitive salticids. As such, the roles of these two factors in driving speciation within the Salticidae family can be better assessed.

MATERIALS AND METHODS

Scanning Electron Microscopy (SEM)

The organs in P. labiata and P. fimbriata were studied under SEM. specimens were carbon-coated using the JEOL JEE-4X Vacuum Evaporator and subsequently gold pated with the JEOL JFC-1100 Fine Coat – Ion Sputter. They were observed under the JEOL JSM-T220A Scanning Microscope and the JEOL JSM-6700F Field Emission Scanning Electron Microscope at 10-20 KV.

Behavioural Experiments

Two sets of experiments were conducted on P. fimbriata. The first was with females whose spinnerets were covered with spray-on bandage. The second was a repetition of the first (same male-female pairs) but females had their spinnerets and abdominal mytiliform organs covered.

Female ‘source’ spiders were individually placed in petri dishes with filter paper for 48 h. The test apparatus consisted of a Y-shaped chamber (Fig. 1) with passageways for movement of the male ‘test’ spider into the arms (containing either clean filter paper or filter paper previously exposed to female). Each test lasted 10 min. First choice (i.e. correct or wrong arm) and duration (i.e. time spent in respective arms) were recorded for both sets of experiments and compared.

![Figure 1. Y-chamber. f: filter paper (one clean and the other exposed to a female). p: passageway. e: entry chamber. d₁: opaque divider. d₂: removable divider to contain male during acclimatization.](image-url)
RESULTS

Abdominal ‘Secretory’ Organs

The abdominal ‘secretory’ fields (Fig. 2A) are located on the dorsum of the abdomen. Each mytiliform organ possesses a pore and a longitudinal gully (arrowed in Fig. 2B).

At the distal end of the tibiae and on the femora of the specimens, organs that resembled the mytiliform organs were found. These organs also possessed pores and gullies.

![Figure 2. A: mytiliform field, ×350. B: mytiliform organ (note gully arrowed), ×4500.](image)

Behavioural Experiments

First choice When females had only spinnerets covered, there were 11 incidences of correct and four incidences of wrong choice made by males (binomial test, N=15, P=0.118). When females had both spinnerets and mytiliform fields covered, there were seven incidences of correct, six incidences of wrong and two incidences of no choice by males (binomial test, N=13, P=1.000).

Duration Males spent more time in the arm which contained filter paper that had been exposed to females that had their spinnerets covered (Paired t test, t₁₄=3.602, P=0.003). However, there was no evidence that they discriminated between clean filter paper and filter paper that had been exposed to females that had both spinnerets and abdominal mytiliform fields covered (Paired t test, t₁₄=0.497, P=0.627). When comparing the same male-female pairs before and after the female’s abdominal mytiliform field was covered, it was shown that males spent more time in the arm with the filter paper exposed to females with only their spinnerets covered (Paired t test, t₁₄=2.806, P=0.014).

DISCUSSION

Abdominal ‘Secretory’ Organs

The occurrence of abdominal ‘secretory’ organs in both genders of *P. labiata* and *P. fimbriata* is interesting because males search for females and not vice versa (Jackson, 1982a), implying that females are probably more active in producing sex pheromones. If indeed these organs are
functionally similar in both genders, they would presumably produce a different blend of sex pheromones. It is probable that although the male pheromones do not elicit courtship or searching behaviour in females (Clark and Jackson, 1995), they might increase the female’s receptivity to mating and possibly reduce cannibalistic tendencies. Male pheromones may also contain information about the male’s genotype, providing a mechanism against inbreeding.

Mytiliform fields are found in *P. labiata* and *P. fimbriata* juveniles as well. If these organs are capable of producing airborne pheromones in sub-adult females, this may reasonably enhance the ability of males to locate them for cohabitation, which is a mating tactic in *Portia* (Jackson, 1986a).

**Behavioural Experiments**

My results suggest that male *P. fimbriata* are less attracted to females when their abdominal mytiliform fields are covered. These results are consistent with the hypothesis that these mytiliform organs are sites of sex pheromone production. Whether these sex pheromones are a mixture of both contact and airborne chemicals cannot be ascertained as of yet but it is probable that they, at least, consist of olfactory pheromones. This is because the pheromones which were absorbed onto the filter paper can only be volatile as the mytiliform organs on the abdomen did not come into contact with the paper.

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**REFERENCES**


