

INFLUENCE OF DISTURBANCE OF HONEYBEE COLONIES ON VENOM PRODUCTION

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Summary

The amount of venom produced by honeybee (*Apis mellifera*) workers from disturbed and non-disturbed colonies was measured. To disturb colonies, workers were crushed and left inside the nest. The average dry mass of venom obtained from individual workers taken from disturbed and non-disturbed colonies was 0.146 mg and 0.151 mg, respectively. The difference between the groups was not statistically significant. The results suggest that disturbance of a colony does not influence the amount of venom produced by workers. In another experiment the amount of venom obtained by electrical stimulation was compared with the amount of venom obtained by stinging leather. The average dry mass of venom obtained by electrical stimulation was 0,116 mg and the average dry mass of venom obtained by stinging leather was 0,160 mg. The amount of venom obtained from the average worker in both experiments was greater than in other studies.

Keywords: *Apis mellifera*, honeybee, bee venom, stinging.

INTRODUCTION

Honeybee workers defend their colony by stinging intruders. One of the signals that incite the defensive attacks is the presence of alarm pheromones (Seeley 1985). The alarm pheromones are produced by mandibular glands (Boch et al. 1970) and cells lining the sting chamber (Collins and Blum 1982). These substances are given off by workers during an attack but also evaporate from the crushed bodies of bees. It can be expected that workers exposed to a frequent presence of alarm pheromones in a colony will produce more venom. This would make their fight with intruder more effective. The aim of this study was verification of a hypothesis assuming that workers from regularly disturbed colonies produce more venom than workers from non-disturbed colonies. Dry mass of venom produced by an individual worker was also measured.

MATERIALS AND METHODS

The experiments were carried out in July and August 1999. In the first experiment three disturbed and three non-disturbed colonies were used. In each colony, 30 emerging workers were marked with enamel. The disturbance

of a colony was simulated by crushing 20 workers and leaving them inside the colony. The procedure was repeated every day for 12 days. At the end of the trial, 10 previously marked workers were collected randomly from each colony, and checked for the amount of venom they produced. To obtain venom, the workers were placed in a plastic tube and electrically stimulated (24 V AC current source), by exposing them to 10 impulses, each lasting 3 seconds (Benton et al. 1963). Stimulated workers repeatedly protruded their stings and ejected venom. The venom was collected on pre-weighed blotting paper discs (6 mm in diameter). After 24 hours at room temperature, the discs were re-weighed. METTLER UMT2 balance was used.

Because the measured amount of venom was unexpectedly large, a further experiment was carried out to verify if the method described above was reliable. Foraging workers of unknown age were used in the experiment. They were divided into two groups, each consisting of 30 workers. To collect venom from workers belonging to the first group, the workers were electrically stimulated as described above. The workers from the second group were forced to sting a piece of leather (6 x 6 mm). Each worker from the second group was placed in plastic tube and its head was pressed to induce stinging. After stinging the worker became detached from the sting, which was allowed to remain in the leather for 2 minutes before it was removed. Only the smooth side of the leather was exposed to stinging. The rough side was covered with self-adhesive tape to prevent changes of the mass of the pieces due to the breaking away of small fragments. The weighing procedure was conducted in the same way as in the first experiment.

RESULTS

Table 1

Average dry mass of venom obtained from honeybee workers in two experiments. Student's t-test was used in statistical analysis.

Średnia sucha masa jadu pobrana od robotnic pszczoły miodnej w dwóch eksperymentach. Do statystycznego porównania danych użyto testu t Studenta.

Experiment Eksperyment	Group Grupa	n	Dry mass of venom ± SD (mg) Sucha masa jadu ± SD (mg)	P
I	Disturbed Niepokojone	30	0.146 ± 0.043	0.762
	Non-disturbed Nie niepokojone	30	0.151 ± 0.079	
II	Electrically stimulation Drażnione prądem	30	0.116 ± 0.063	0.003
	Stinging leather Żądłace skórę	30	0,160 ± 0.046	

In the first experiment the differences between the colonies in each group were not statistically significant and the data from different colonies in both groups were combined. The dry mass of venom obtained from the average individual worker belonging to disturbed and non-disturbed colonies did not differ significantly (Table 1). In the second experiment significantly more venom was obtained from workers stinging leather than from workers electrically stimulated (Table 1).

DISCUSSION

The results suggest that disturbance of a colony does not influence the amount of venom produced by an individual worker. The amount of venom obtained was considerably higher than in an earlier estimation (Gałuszka 1972). To measure the amount of venom produced by one worker Gałuszka (1972) assessed the dry mass of venom collected from 1000 workers and averaged the resulting weight to produce a mean quantity per worker. She found that one worker produced 0.011 mg of dry venom. The amount of venom collected in this study was much larger. Although Gałuszka (1972) investigated greater number of workers, the results presented here seem to be more precise because of the method used. Venom was collected from individual workers and it was weighed with high precision. To verify that the results were reliable the measurement was repeated and two methods were used. Although the amount of venom collected by electrical stimulation was significantly less than that obtained by stinging leather, the dry mass of obtained venom is more than 10 times greater than had earlier been estimated.

CONCLUSIONS

1. Disturbance of a honeybee colony does not influence the amount of venom produced by an individual worker.
2. Dry mass of venom produced by an individual honeybee worker is greater than earlier estimated.

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WPLYW NIEPOKOJENIA RODZIN PSZCZELICH NA PRODUKCJĘ JADU

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S t r e s z c z e n i e

W pierwszym eksperymencie weryfikowano hipotezę zakładającą, że robotnice z rodzin niepokojonych produkują więcej jadu niż robotnice z grupy kontrolnej. Do eksperymentu wykorzystano 6 rodzin. Trzy rodziny z grupy eksperymentalnej niepokojono, natomiast pozostałe 3 rodziny stanowiły grupę kontrolną. W każdej rodzinie zaznaczono po 30 wygryzających się robotnic. Niepokojenie polegało na rozgniataciu robotnic i pozostawianiu ich wewnątrz gniazda. W ten sposób niepokojono rodziny przez 12 dni. Po tym czasie, pobrano z każdej rodziny po 10 oznaczonych robotnic. W celu pobrania jadu robotnice drażniono prądem. Drażnione robotnice wysuwały żądło, z końca którego zbierano jad na zważone wcześniej krążki bibuły filtracyjnej o średnicy 6 mm. Aby określić suchą masę jadu krążki te ponownie ważono po 24 godzinach. Ponieważ uzyskana masa jadu była większa niż oczekiwano przeprowadzono drugi eksperyment. Polegał on na pobieraniu jadu dwoma metodami. Pierwsza metoda była taka sama jak opisano powyżej. Natomiast druga metoda polegała na nakłanianiu pszczoły do żądlenia skrawka skóry. Skrawki skóry miały kształt kwadratu o boku około 6 mm. Badaną robotnicę umieszczano w rurce z tworzywa sztucznego i aby nakłonić ją do żądlenia naciskano delikatnie na jej głowę. Po użądleniu robotnicę odrywano od aparatu żądłowego. Żądło pozostawało wbite w skórę przez 2 minuty po czym usuwano go. Ważenie przeprowadzono tak samo jak w pierwszym eksperymencie.

Sucha masa jadu pobranego od jednej robotnicy z rodziny niepokojonej wyniosła $0,146 \pm 0,043$ mg (średnia \pm SD), natomiast sucha masa jadu pobranego od jednej robotnicy z grupy kontrolnej wyniosła $0,151 \pm 0,079$ mg. Różnice te nie są statystycznie istotne. Sucha masa jadu pobrana metodą żądlenia skóry ($0,160 \pm 0,046$ mg) była statystycznie istotnie większa od suchej masy jadu pobranej metodą drażnienia prądem ($0,116 \pm 0,063$ mg). Masa jadu pobrana od pojedynczej robotnicy w obu eksperymentach była znacznie większa niż wcześniej sugerowano.

Słowa kluczowe: *Apis mellifera*, pszczoła miodna, jad pszczeli, żądlenie.