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Preliminary Report on Olfactory Neurons Specific to the Sex Pheromone of the American Cockroach. Minoru Yamada* (Fisheries Laboratory, Faculty of Agriculture, Nagoya University, Nagoya) Shoziro Isii, Yasumasa Kuhara (Pesticide Research Institute, College of Agriculture, Kyoto University, Kyoto) Received February 15, 1968, Bolsh-Kagaku, 33, 37, 1968.

Materials and Methods

The adults of the American cockroach bred in the laboratory were used. An unanaesthetized cockroach was fixed with adhesive tapes and wire hooks on a cork plate so that the head could not be moved. The brain was approached dorsally through the frons, and the minimum amount of the overlying tracheation was removed. Recording of the electrical responses was made extracellularly by means of a glass capillary electrode filled with 3M KCl solution. The electrical resistance of the electrode ranged between 30MΩ and 50MΩ.

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Results and Discussions

Figure 1 shows the examples of the single unit activity of the male cockroach. Propionic acid induced a positive slow potential (upward deflection) which was sustained during the stimulation, while the discharge of impulses was depressed. After the cessation of stimulation the units exhibited an increased activity (Fig. 1 A). It is interesting to note, on the other hand, that the prepurified sex pheromone (Fig. 1 B) and methylethyl ketone (Fig. 1 C) produced a negative slow potential (downward deflection) accompanied by a burst of activity which was followed by a silent period and a gradual increase to the normal background activity. These changes in activity may be explained in terms of hyperpolarization or depolarization of the membrane. These units that are sensitive to both the sex pheromone and other odors were frequently found in both male and female of this insect.

Figure 2 shows the responses of the highly specific neurons to odor stimuli. The recordings were made from the same male cockroach as that used in Figure 1. The unit was not spontaneously active, but responded vigorously to the sex pheromone with a slow negativity accompanied by a train of impulses during the

Fig. 1. Responses of a neuron in the deutocerebrum of the male cockroach to propionic acid (A), prepurified sex pheromone (B), and methylethyl ketone (C). Upper tracings are AC recordings (calibration 2mV), and lower tracings DC recordings. Time calibration 200msec. The downward deflection represents negative potential at the recording electrode. The black bars below each tracing indicate the duration of the stimulation.

Fig. 2. Responses of a neuron in the deutocerebrum of the male cockroach to the prepurified sex pheromone (A) and methylethyl ketone (B), and those of the female cockroach to the prepurified sex pheromone (C) and methylethyl ketone (D). Calibration: 1mV, 200msec. in A and B; 0.5mV, 200msec. in C and D.
stimulation (Fig. 2 A). However, it failed to respond to other types of odor stimuli tested, for examples, propionic acid, acetic acid, benzy acetate, p-dichlorobenzene, 2-methyl-2-butanol, acotophenone, geraniol, 1,2-dichloroethane, trichloroethylene, cycloheptanone, diethylsulphate, cyclopentanone, ethyl ether, methyl alcohol, methylethyl ketone. A neuron of the female also showed such a high specificity to the prepurified sex pheromone as in the male (Fig. 2 C and D). However, this unit showed spontaneous discharges.

Because of the stimulations with the prepurified sex pheromone and the small number of odorous chemicals tested, it is difficult to draw the conclusion about the "Sex pheromone neuron". Although the present experiments were failed to elucidate that the sex pheromone elicits sexual response only to the male and not to the female and nymph by electrophysiological method in the neuron of deutocerebrum of both sexes, it is of interest that the present finding together with the responses at the recepter level", suggests a possibility that these extremely specific units in both sexes may play an important role in response to the sex pheromone.

If so, it may be considered that there it no discrimination in response to the sex pheromone in the neuron of deutocerebrum between male and female of the american cockroach.

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References