THE EFFECT OF MUTATIONS OF KINURENIN PATHWAY OF TRIPTOPHAN TRANSFORMATION ON THE ACTIVITY OF NERVOUS SYSTEM AND BEHAVIOUR OF THE HONEYBEE

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For many years, the laboratories of the Pavlov Physiology Institute in Leningrad, together with the Agricultural University in Warsaw, have investigated the effect of mutations on the activity of the nervous system and behaviour of the honeybee. The eye mutations disturb the kinurenin pathway of triptophan transformation (KPTT), and thus block the transformation of triptophan into the ommochrome in the bee eye.

The aims of this research are as follows:

1. Mutations with known biochemical expression are good models for solving one of the most important question of behavioural genetics, namely to trace the way and mechanism of gene activity in the reaction of the nervous system and behaviour.
2. Triptophan itself, as well as its derivatives, are neuroactive. Therefore the investigation are important for general neurophysiology as well as for insect neurophysiology in particular.
3. KPTT is intensified under stress conditions of most mammalians. It is believed that this intensification is responsible for chronical stress and results in the nervous pathology of people.

Four eye mutations of the honeybee were investigated: snow (s) laranja (s^{la}), which result in cumulation of triptophan and serotonin, umber (i^{u}), which results in cumulation of kinurenin, and brick (bk), which result in cumulation of 3-hydroxykinurenin.

The results showed that these mutations can be grouped into two as regards their influence on the nervous system and the behaviour of the bees. Snow and laranja mutations restrain the nervous activity which results in lower motion activity, in slower rhythm bee dances, in lower bioelectrical activity and lower resistance to ether. Contrary, umber and brick mutations stimulate the nervous activity, which results in effects opposite to those described above.

It was concluded that triptophan restrains nervous activity, and kinurenin stimulates it. This was proved experimentally, by injecting these substances into the bee body.

It was shown also that snow and laranja mutations decreased the muscle reaction to electrical impulses in the larval stage and umber mutation increased it.

Next, conditional reflexes of normal and mutant bees of different ages were investigated. Fifteen bees were fasted by their wings to a metal bar. A drop of perfumed syrup or water was brought close to their first pair of legs. This resulted in the conditional alimentary reflex of stretching the tongue of some bees. Figure 1 shows the reaction of the four genotypes. The conditional reflex of normal bees increased up to the age of 7 days, when the worker start normally to fly out of the hive. Later on no significant changes were noticed. The reflex of laranja bees, which have a high cumulation of tryptophan, increased for 3 days more, up to the age of 10

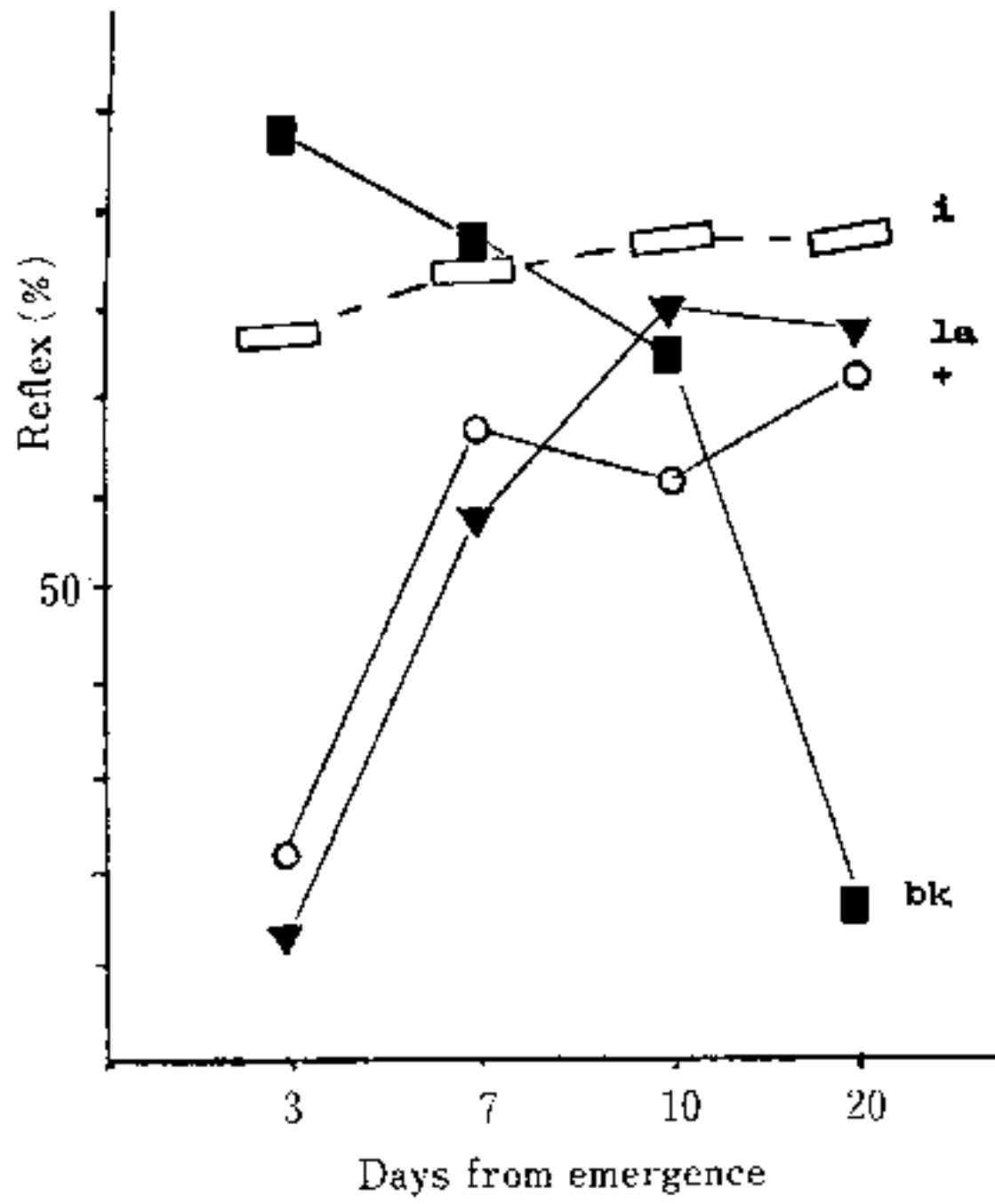

Fig. 1. Changes of alimentary conditional reflex in honeybee mutants.

days.

The conditional reflex of umber workers, which have a high cumulation of kinurenin, was very high in 3 day old bees and remained at this high level up to the end of the experiment. The reflex of these mutants was always higher than that of normal bees.

The conditional reflex of brick bees, which have a high cumulation of 3-hydroxykinurenin, was very high in 3 day old bees, and decreased later on. In bees 7 days old, it was about the same as in umber mutants, at 10 days it was as high as in laranja bees of the same age, and at 20 day it was as low as in 3 day old normal workers.

Thus the above results show, that the behaviour of bees depends on the genotype and it changes in different directions with the progress of ontogenesis.

The character of the changes depends upon biochemical substances that have accumulated in the bee body. Cumulation of triptophan and serotonin results in a decrease of the reaction in young bees, and cumulation of kinurenin, in an increase.

All this show that investigation of kinurenin pathways of triptophan transformation in bees is able to resolve many problems important for general physiology as well as for the pathology of animals and people.

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