THE INFLUENCE OF CERTAIN NEUROPSYCHOTROPIC SUBSTANCES ON FOOD SELECTION AND ITS REGULATION IN DOGS

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Regulation of the specialized forms of behavior in relation to food, involved in the selective consumption of certain foodstuffs and rejection of others, is determined in significant measure by the impulses arising from stimulation of interoceptors [3-6]. It may be considered that in the process of food selection the animals exhibit two reaction types: the biologically positive or alimentary (consumption of the milk + salt solutions) and the biologically negative or protective reaction (refusal to consume certain of the milk + salt solutions offered). It has been found that some neuropsychotropic substances evidence a selective effect on reactions of distinct biological significance. Thus, aminazine produces a preferential inhibition of those nerve structures in the reticular formation of the brain stem which excite the cerebral cortex during biologically negative reactions [1, 2, 6-9].

The aim of the present work was to investigate the change in food selection under the influence of aminazine.

Considering that, under the action of this preparation, the protective component of the selection reaction would be largely suppressed, it seemed timely also to study the change in food selection under the influence of neurotraumatizing situations; under the latter circumstances the defensive state of the animals would be heightened. Finally, it was of interest to study the effect of Tofranil, a preparation exhibiting antidepressant activity, though similar to aminazine in many pharmacological effects.

METHOD

The work was carried out on two gastric fistula dogs (Zhulik and Orel). In all, 247 experiments were performed. A 5% sodium chloride solution was used as the stimulant for the stomach receptors and this was assessed for its effect on the feeding behavior in relation to salt dissolved in milk. The animals were placed on the experiment after an 18 to 22 h fast. The dog was placed on the bench in a harness and a covered food trough containing 6 food cups was set before the animal; 4 of the cups contained 15 ml of milk, each with a different concentration of salt (usually between 1 and 5%), the fifth contained 15 ml of plain milk, and the sixth contained water. At the start of each test the cover was removed from the trough and the animal given the opportunity to choose which liquid to consume. The solutions that were drunk were led off through the fistula tube which had been opened at the time of the experiment. After each test the stomach was washed out with warm water. The lapping movements were recorded. The characteristics of the food selection reaction were investigated under normal conditions, and against a background of neuropsychotropic drug influence aminizine and Tofranil and also in animals at various stages in the development of the neurotic state.

RESULTS

Preliminary experiments established that the limit of salt concentration, above which the animals would refuse the milk-salt solution, was 3.5% for Zhulik and 5% for Orel.

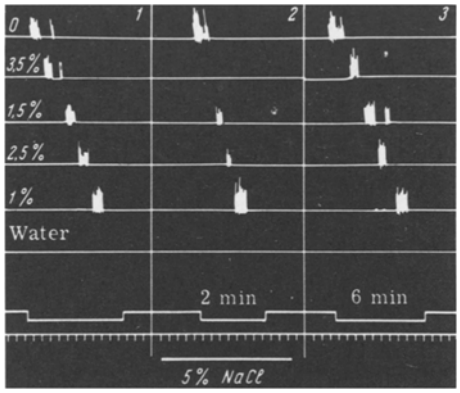

Fig. 1. Decrease of the salt appetite in the dog Zhulik after brief stimulation of the stomach receptors with a hypertonic salt solution. 1) Original selection—the milk-salt solutions were consumed in the order of distribution of the cups without regard to the salt concentration; 2) 2 min after placing 300 ml of 5% NaCl solution in the stomach cavity, the dog completely rejected the 3.5% solution but the 2.5% solution was partially consumed. Figures at the left show the NaCl content of the milk-salt solutions; the lines on the diagram correspond each to one of the solutions and on each line the drinking of that solution by the dog is recorded. The number of the trial is shown above. The second line from the bottom denotes the opening and closing of the food trough. The lower line shows the time (intervals of 5 sec). The 5% sodium chloride solution was left in the stomach for the period of time denoted by the segment labeled "5% NaCl."

Previous experiments have confirmed the fact, reported in the literature [3-5] that there is a reflex diminution in salt appetite after a hypertonic sodium chloride solution is introduced into the lumen of the stomach. Thus, in 32 experiments on Zhulik it was found that even when the salt solution was present in the stomach for a short time (2-5 min) the animal would refuse the more concentrated solutions and would drink the remaining ones strictly in the order of increasing salt concentration in the milk (Fig. 1). The recovery period varied from 6 to 15 min (sometimes as much as 21 min). In 19 food selection experiments we studied the effect of hypertonic sodium chloride solution in the stomach over a period of 10 min. The dogs in such experiments refused 2 or 3, and often all of the milk-salt solutions, selecting only the nonsalted milk during the first 10-20 min after treatment. The selection reaction was completely normalized after 30-37 min (sometimes 60 min).

In the dog Orel a change in the selection reaction appeared only when the salt solution was in contact with the stomach for 8 to 13 min. This long latent period was associated with the longer recovery period of the reactions which in this case was 1-1½ h in most experiments.

The experiments on administration of aminazine and Tofranil were carried out in such a way that one substance was studied first and after 7-12 days, when the period of its effect was ended, the other was tested. The reflex action from the stomach receptors upon the food selection behavior was eliminated by the psychotropic substances. The smallest dose of aminazine that would completely inhibit the reflex action from the stomach receptors upon the food selection in both dogs was 0.5-0.7 mg/kg and that of Tofranil was 2 mg/kg. At these dosages both preparations nearly always changed the pattern of consumption of the milk-salt solutions by the animals. There was haste in the selection of solutions and they were consumed in fractional amounts, the animal returning several times to each cup with no regard to their relative position in the tray or to their salt concentration.

Placing hypertonic salt solution in the stomach on a background of aminazine or Tofranil did not elicit the usual curtailment of salt appetite. The consumption of the offered solutions by the animals was independent of cup order and was the same in character after placing the salt solution in the stomach as it had been prior thereto. It frequently occurred in a series of such tests that the animals would select a solution of highest concentration first: Zhulik selected the 3.5% solution first while Orel first selected the one at 5% (Fig. 2).

Experiments with the neurotic state were conducted with Zhulik.* In these experiments as in the preceding studies a complex of strong external stimuli were employed (sham conflagration, drenching with water from a hose, throwing a cat at the dog under experiment, teasing with meat when the dog was in a state of excitement for feeding after a 2 or 3 day fast). These stimuli were applied 12 times in the course of 2½ months at intervals ranging from 1 day to 2 weeks. Zhulik reacted to the stimuli with sharp motor excitation [6]. Distinct disorganizations in the selection reaction could be observed even after the first neurotraumatic stimulation. A strong decrease in salt appetite was common to these experiments. Such a reaction was frequently noted in the opening experiments (Fig. 3), and tests with the action of hypertonic sodium chloride solution on the stomach receptors had little significance.

* The dog Orel, following abrupt cessation of large doses of Tofranil, developed a sudden disturbance in the nature of the selection reaction as well as in general condition.

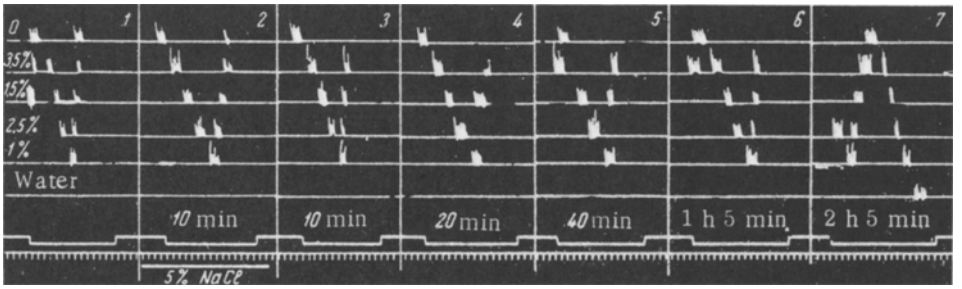

Fig. 2. The absence of changes in the selection of milk-salt solutions by the dog Zhulik while under the influence of aminazine (0.7 mg/kg intramuscularly) when the stomach receptors were stimulated with 5% NaCl solution. 1) Initial selection—the solutions were consumed in fractional amounts at different times independent of the salt concentration; 2) selection of the milk-salt solutions under the influence of aminazine did not change after placing 300 ml of 5% salt solution in the stomach cavity; 3-7) in the course of a longer period of observing the character of the selection reaction it remained the same as that noted in the starting experiment. In some trials (5, 6, 7) the first selection was from the higher concentration solutions (3.5 and 2.5%). Symbols are the same as those in Fig. 1.

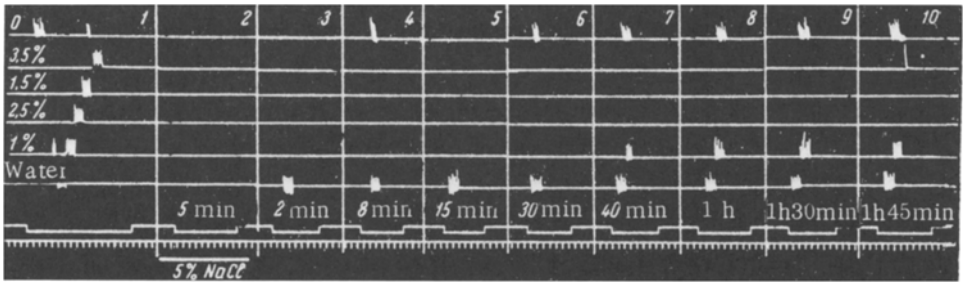

Fig. 3. Abrupt and prolonged diminution in the salt appetite of Zhulik during short term stimulation of the stomach receptors with hypertonic NaCl solution while under the influence of superpowerful emotional stimulation (sham conflagration); 1) initial selection—the solution with the highest salt concentration was consumed last; 2) when 5% NaCl solution was placed in the stomach the dog refused all the solutions offered; 3-6) after emptying and washing out the stomach the dog refused practically all except water; 7-10) in the course of 1 h and 45 min observation the 1.5, 2.5, and 3.5% solutions were not selected. Symbols as in Fig. 1.

In certain experiments, in which the diminution of salt appetite was less pronounced, the placing of hypertonic saline in the stomach cavity led to a more pronounced decrease in salt appetite than it did under the normal conditions. Such an abrupt decrease in salt appetite in experiments with the effect of strong emotional stimulation were observed in the animal under the influence of powerful food motivation (after 2-3 days of fasting).

The experimental findings presented permit the conclusion that the situation in the experiments on the selection of food produces two types of reactions in the animals. On the one hand, the dogs readily consumed the milk-salt solutions, evidencing a biologically positive reaction—the feeding reaction; on the other hand, they refused certain of the solutions offered, evidencing a biologically negative reaction—defensive reaction. The character of the selection reaction in its entirety is a result of the relationship between these two kinds of reactions.

In the healthy dog the normal operation of nerve processes insures the most perfect regulation of food selection. With such animals the limiting concentration of the selected milk-salt solutions is quickly established. Within these limits the animals consume the solutions without regard to concentration. When a hypertonic saline

solution is introduced into the stomach the animals reject the solutions at the higher salt concentrations, thus, protecting themselves against an excessive supply of salt to the organism, which would produce a disturbance in homeostasis [3-5].

The experiments demonstrated that under the influence of neurotraumatizing situations the predominating reactions beome those of self-protection. This brings to the foreground the biologically negative components of the selection reaction which support the animals in a defensive condition. Thus, a marked decrease in salt appetite is observed, which is not associated with the appearance of an excessive sodium chloride concentration in the organism.

Under the influence of the neuropsychotropic substances we have employed, the character of the food choice reaction changed in the opposite direction. The salt appetite is increased: the dogs readily consume the milk-salt solutions even after hypertonic sodium chloride is placed in the stomach cavity. This appears to us to warrant the theory that under the influence of aminazine and Tofranil the biologically negative component of the selection reaction is eliminated, while the biologically positive components remain clearly in evidence.

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