

EFFECT OF DEAFFERENTATION OF THE RAT TONGUE ON PLASMA CORTICOSTERONE,
ALDOSTERONE, ANGIOTENSIN AND ACTH LEVELS

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The results of numerous investigations have demonstrated the important role of the taste receptor apparatus in regulating the consumption both of nutrients and of compounds necessary to maintain the constancy of the internal milieu of the organism.

We know that the taste apparatus plays a special role in regulation of the sodium ion balance. The writers' investigations have shown that after bilateral division of afferent taste fibers of the chorda tympani, which run in the composition of the lingual nerve, in rats the animals' behavior as regards the consumption of and preference for sodium chloride solutions changes: the number of animals preferring salt solution to water increases and the trend of the daily consumption of this solution is disturbed [1]. Since after division of the lingual nerve in rats a deficit of sensory information from the receptors of the tongue develops, it was suggested that this sensory deficit leads to a change of emotional state and a consequent disturbance of the balance of hormones regulating sodium homeostasis, and to a probable lowering of the sodium ion level in the body. The change in the sodium ion level in rats disturbs their motivational attitude to sodium chloride solution.

In this investigation the effect of deafferentation of the tongue on the plasma level of hormones involved in regulation of the sodium ion level — aldosterone, corticosterone, ACTH, and angiotensin — was studied.

EXPERIMENTAL METHOD

Experiments were carried out on 90 male laboratory rats weighing 250-300 g. Under pentobarbital anesthesia (40 mg/kg) bilateral extirpation of a segment of the lingual nerve (4-5 mm long) was carried out and control animals were subjected to a mock operation [1, 3, 4]. To determine the hormone concentration, blood samples were taken 8-10 days after the operation by rapid decapitation of the animals. The blood samples were then centrifuged at 1500g and at 2-4°C for 15 min. The plasma was kept until required for determination of the hormone concentration at -20°C. Plasma hormone levels were determined by radioimmunoassay: ACTH, angiotensin I, and aldosterone by means of kits (from CIS IRE-Sorin, France-Italy) [7, 8, 11]. The corticosterone level was determined with the aid of a highly specific antiserum obtained in the laboratory of endocrinology (Head, G. P. Katsiya), Institute of Experimental Pathology and Therapy, Academy of Medical Sciences of the USSR. The results were subjected to statistical analysis by the Student-Fisher methods.

EXPERIMENTAL RESULTS

Investigations of the concentrations of hormones regulating the plasma sodium level showed that after bilateral division of the lingual nerve in rats the plasma corticosterone concentration was higher than the concentration of this hormone in rats undergoing the mock operation. The plasma aldosterone concentration of the deafferented animals also was higher than in the control. The question accordingly arises of the connection between orosensory (taste, in particular) perception and hormonal homeostasis and sodium balance in the body.

It is known that systemic administration of deoxycorticosterone can induce an increase in consumption of sodium chloride solution in rats [9, 14, 16]. The effect of taste percep-

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tion on the plasma corticosterone level also was studied in young rats treated by intrauterine injection of physiological saline or apple juice into the amniotic fluid of the pregnant mother. In these young rats the plasma corticosterone level was lower than in animals undergoing the mock operation [15]. It was shown at the same time that a high concentration of adrenocorticoid hormones is an indicator of the stress state of animals [5]. To explain the results of this investigation it can be postulated that a partial deficit of sensory information from the receptors of the tongue (after bilateral division of afferent fibers of the chorda typani in the composition of the lingual nerve, taste afferentation is provided by fibers of the glossopharyngeal and vagus nerves, innervating receptors of the root of the tongue and pharynx), leads to a negative emotional state in rats, as a result of which the animal develops a stress reaction. This reaction must lead to more intensive functioning of the pituitary-adrenal system and to increased production of ACTH and corticosteroid hormones. Unfortunately, despite the high levels of corticosterone and aldosterone in deafferented rats, the ACTH level in these animals did not differ significantly from the control, but was depressed a little (330.5 ± 90.93 and 527.2 ± 113.93 pg/ml, respectively, $M \pm m$). This can probably be explained on the grounds that pituitary activity and ACTH production precede corticosterone synthesis, and in these experiments the ACTH level corresponded to the stage of recovery. The stressor state created in the rats in these experiments by the sensory deficit, and the high corticosterone concentration, probably lead to loss of sodium and increased consumption of sodium chloride, as was observed in mice [12].

Meanwhile the aldosterone level in rats is determined not only by the ACTH concentration but also by activity of the renin-angiotensin system, and also by the sodium ion concentration [2, 5, 6, 10, 13]. Since the plasma angiotensin I level in the deafferented rats was not raised, it can be postulated that as a result of the high corticosterone level it is the sodium deficit that intensifies aldosterone synthesis in the adrenal cortex. These processes may explain the high concentrations of corticosterone and aldosterone in the plasma of the deafferented rats and preference of these rats for sodium chloride solutions, as was studied previously. The results indicate the important role of orosensory and, in particular, taste perception in the complex processes of regulation of the sodium balance in the body, which involve the pituitary-adrenal system in the mechanism of regulation.

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