

SECRETION OF ENZYMES BY SALIVARY GLANDS AND ENZYME HOMEOSTASIS UNDER THE SEPARATE AND COMBINED INFLUENCE OF HIGH TEMPERATURE AND INSOLATION

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Эксперименты проведены на 150 белых нелинейных крысах-самцах, в возрасте 2,5 мес, средней массой 150-200 г. Полученные результаты показали, что высокая температура и инсоляция подавляют секрецию ферментов слюнных желез: амилазу и пепсиноген, а на липазу они не влияют.

Однонаправленные изменения активности амилазы и пепсиногена в слюнных железах и в крови при действии высокой температуры указывают на значимость слюнных желез в их гомеостазе.

The experiments were conducted on 150 white nonlinear male rats, aged 2.5 months, with an average weight of 150-200 g. The results showed that high temperature and insolation suppress the secretion of salivary gland enzymes: amylase and pepsinogen, but they do not affect lipase.

Unidirectional changes in the activity of amylase and pepsinogen in the salivary glands and in the blood under the influence of high temperature indicate the importance of the salivary glands in their homeostasis.

Актуальность работы. Высокая температура и инсоляция, как климатический фактор оказывают значительное влияние на организм. Реакция организма на действие высокой температуры и инсоляции чрезвычайно многообразна и сложна. Под их воздействием нарушается водно-солевой обмен, что приводит к глубоким изменениям в деятельности сердечно-сосудистой системы, органов пищеварения и выделения, изменяются морфологический состав и свойства крови [1, 2, 6, 7, 8, 9, 10]. Саливация в своем объеме в большой мере зависит от гидратированности организма [3], резко понижаясь даже при небольшой дегидратации. В этих условиях концентрация многих рекретируемых веществ в составе слюны повышается, а их дебиты могут снижаться.

По литературным данным слюнные железы рассматривались как орган принимающий участие в терморегуляции [1, 6] и нет работ посвященных влиянию высокой температуры и инсоляции на ферментовыделительную деятельность слюнных желез.

Relevance of the work. High temperature and insolation, as a climatic factor, have a significant impact on the body. The body's reaction to the action of high temperature and insolation is extremely diverse and complex.

Under their influence, water-salt metabolism is disrupted, which leads to profound changes in the functioning of the cardiovascular system, digestive and excretory organs, and changes in the morphological composition and properties of the blood [1, 2, 6, 7, 8, 9, 10].

Salivation in its volume largely depends on the hydration of the body [3], sharply decreasing even with slight dehydration. Under these conditions, the concentration of many secreted substances in the saliva increases, and their debits can decrease.

According to literary data, the salivary glands were considered as an organ participating in thermoregulation [1, 6] and there are no works devoted to the influence of high temperature and insolation on the enzyme-secreting activity of the salivary glands.

Purpose of the Study. The purpose of work was to study the enzyme-secreting activity of the salivary glands under the separate and combined influence of high temperature, insolation and to determine the possibility of secreting some hydrolytic enzymes in saliva, secreted by other digestive glands (stomach, pancreas, intestines).

Material and methods. The experiments were conducted on 150 white nonlinear male rats, aged 2.5 months, with an average weight of 150-200 g, kept under standard conditions in the vivarium of the institute.

The study included 3 groups of animals: 1st (n=50) - intact animals not exposed to any influences (at an ambient temperature of 20-25°C, control), 2nd (n=50) - rats at an ambient temperature of 37-40°C, 3rd (n=50) - rats in the summer - June-July (at an ambient temperature of 37-40°C) during the entire duration of the experiment were exposed to insolation on the sun platform, daily at 1200 hours of the day, for 30 minutes.

The rats were anesthetized with ether immediately before slaughter, they were killed by decapitation, and then their blood was collected. After slaughtering the animals, their parotid, submandibular and sublingual salivary glands were removed. The following enzymes were determined in the homogenate of the salivary glands and in the blood serum: amylase, pepsinogen, lipase.

Enzymatic activity was related to 1 g of gland tissue. The obtained data were compared with the control values.

Results and discussion.

The data we obtained showed that at high ambient temperatures (Table 1) the amylolytic activity of salivary gland homogenates and blood decreases sharply.

In the first group of rats, when they were exposed to only one elevated temperature (without insolation), the amylolytic activity of homogenates of the submandibular and sublingual salivary glands and blood serum was approximately 6-7 times lower than the indicators of the control group.

And in the homogenate of the parotid salivary gland there was an even more pronounced decrease in amylase activity (its activity was 8-9 times less than the control group). In the second group of rats, when they were exposed to high temperature and insolation, the amylolytic activity of homogenates of the submandibular and sublingual salivary glands decreased approximately 2 times than when exposed to high temperature alone.

This means that the simultaneous action of two stress factors, such as high temperature and insolation, suppresses the activity of amylase of the submandibular and sublingual salivary glands to a greater extent. The amylolytic activity of the parotid salivary gland and blood serum

under the combined action of high temperature and insolation remains at the same level as under the action of high temperature alone.

Table 1

Dependence of amylolytic activity of homogenate (mg/min) of salivary glands and amylase content in rat blood on ambient temperature ($M \pm m$)

Material under study	At a temperature of 20-25 ⁰ C	At a temperature 37-40 ⁰ C	
		Without insolation	After insolation
Homogenate of the parotid salivary gland	7207,8 $\pm$ 99,9	227,5 $\pm$ 21,3*	274,9 $\pm$ 26,2*
Homogenate of submandibular and sublingual salivary glands	7870,9 $\pm$ 481,8	783,8 $\pm$ 70,54*	419,6 $\pm$ 38,4*,**
Blood serum	257,6 $\pm$ 23,2	35,8 $\pm$ 3,49*	40,9 $\pm$ 3,59*

Note: here and in tables 1; 2; 3 * – $p < 0.05$ compared to values at a temperature of 20-25⁰C, ** – $P < 0.05$ compared to values at a temperature of 37-40⁰C without insolation

A more pronounced decrease in the amylase output is observed under the influence of high temperature (Table 1). In the homogenate of the parotid salivary gland, the activity is reduced by 30 times compared to the control group, in the homogenate of the submandibular and sublingual salivary glands, its decrease was 10 times compared to the control.

With the simultaneous action of two factors - high temperature and insolation, the amylase activity in the homogenate of the parotid salivary gland remains the same as with the action of only high temperature, and in the homogenate of the submandibular and sublingual glands, its activity becomes 2 times less than with the action of only high temperature.

The ambiguity of the reaction of the salivary glands in the secretion of amylase, under the influence of high temperature and insolation, can be explained by the presence in the blood serum and saliva of two types of amylase, intrinsic (S) and pancreatic (P) α -amylase. The ratio of these amylases in the saliva of the parotid gland (S - 55-67%; P - 33-44%), submandibular and sublingual salivary glands is not the same [3].

Table 2

Dependence of lipolytic activity of homogenate (mg/min) of salivary glands, lipase content in rat blood on ambient temperature ($M \pm m$)

Material under study	At a temperature 20-25°C	At a temperature 37-40°C	
		Without insolation	After insolation
Homogenate of the parotid salivary gland	0,40±0,10	0,60±0,10	0,40±0,10
Homogenate of submandibular and sublingual salivary glands	0,20±0,10	0,40±0,04	0,50±0,14
Blood serum	3,80±0,32	3,10±0,31	3,20±0,30

This means that the parotid glands secrete saliva with a higher proportion of resecreted pancreatic amylase than the saliva of the other two glands, which is confirmed by the correlation coefficients we obtained between the amylase content in the blood and its secretion by the salivary glands.

The correlation coefficients between the amylolytic activity of the blood and its secretion by the parotid gland are much higher than those of the submandibular and sublingual glands.

From this it can be concluded that the decrease in amylase activity in the salivary glands can be explained by the suppression of the secretion of this enzyme by the salivary glands under the influence of high temperature and insolation, and is also the result of dehydration of the body as a whole and the salivary glands in particular.

Changes in external temperature and exposure to insolation did not affect the lipolytic activity of blood serum and salivary glands (Table 2). Under the influence of high temperature and insolation, its flow rate remained at the level of the control group indicators.

At high external temperatures, the content of pepsinogen in the blood, as well as in the homogenate of the salivary glands and its secretion by the salivary glands decreases (Table 3). In this case, the decrease in the content of pepsinogen in all three salivary glands was approximately the same, 5-6 times less than the indicators of the control group. The same results were also obtained with and without insolation.

Table 3

Dependence of pepsinogen content in homogenate (mg/min) of salivary glands, its content in rat blood on ambient temperature ($M \pm m$)

Material under study	At a temperature 20-25°C	At a temperature 37-40°C	
		Without insolation	After insolation

Homogenate of the parotid salivary gland	33,0±3,0	11,50±1,09*	11,60±1,09*
Homogenate of submandibular and sublingual salivary glands	39,0±3,40	11,20±1,06*	11,00±1,07*
Blood serum	76,20±7,58	35,80±3,52*	31,90±3,08*

The content of pepsinogen in the blood of experimental rats exposed to high temperatures and insolation decreased by approximately 2.8-3.5 times compared to control values.

The main source of pepsinogen in the blood are the chief cells of the gastric glands [4] and pepsinogen in saliva has a recretory nature, i.e. it is secreted from the blood [5].

The high dependence of the content and especially the release of pepsinogen in the saliva on its blood level that we have established confirms its recretory origin in the saliva. The correlation coefficients increase sharply under the influence of high temperature and insolation, i.e. the dependence of the release of pepsinogen in the saliva on its blood level increases.

This means that stress factors such as high temperature and insolation suppress the secretory activity of the main cells of the stomach and reduce the secretion of pepsinogen into the blood, and this leads, accordingly, to a decrease in its secretory release from the blood as part of saliva.

Summarizing the obtained data, it seems possible to draw the following conclusions:

1. High temperature and insolation suppress the secretion of salivary gland enzymes: amylase and pepsinogen, but they do not affect lipase.

2. Unidirectional changes in the activity of amylase and pepsinogen in the salivary glands and in the blood under the influence of high temperature indicate the importance of the salivary glands in their homeostasis.

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