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ANALYSIS OF THE MECHANISM OF DEGRADATIONAL MITOGENETIC RADIATION

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Degradational mitogenetic radiation arises in living objects during moderate cooling (2-5°C), light anesthesia, centrifugation (2500-3000 rpm), the application of a weak (0.02-0.05 ma at 4-6 v) constant or alternating current, or spontaneously, as, for example, in nerve and muscle systems [1, 2, 3].

An analysis of this phenomenon led A. G. Gurvich to the conclusion that in the substance of living objects there are molecular constellations at a high energy level for the maintenance of which statistically uninterrupted influx of energy is required, and that consequently these molecular constellations are not in equilibrium.

According to Gurvich [4], these unbalanced molecular constellations consist of general levels of energy along which absorbed energy migrates and possibly is summated by the constellations. During disturbance of the constellations this energy is partially emitted in the form of degradational radiation, with a spectrum which is determined by the unbalanced state of the molecular constellations. According to A. G. Gurvich's physiological theory of protoplasm [3], the unbalanced molecular constellations constitute the fundamental reactive apparatus of living systems.

We thus see that the importance of studying degradational mitogenetic radiation lies in the fact that first by its appearance or absence during the application of degrading factors to a living object it is possible to judge the intrinsic energy level of that object; in the second place the spectrum of this radiation may give some idea of the state of the general reactive apparatus of living systems – on the state of the unbalanced molecular constellations and on the mitogenetic condition of the nerve and muscle systems.

The above indicates the considerable general biological importance of the study of degradational mitogenetic radiation. However, in the mechanism of its production there is much that still remains unexplained.

The investigation to be described was devoted to the study of the duration of degradational radiation and of the ability of the unbalanced molecular constellations to accumulate energy and to summate small quanta of it. As the subject of the investigation we used the degradational radiation of the liver of the mouse and of the layer of an onion, caused by cooling, and the method of demonstrating it was by the use of biological detectors.

1. Mouse liver. Duration of degradational radiation in relation to the temperature of cooling.

The degradational radiation of the liver during cooling was studied by A. and L. Gurvich [1, 2] and by Iu. N. Ponomareva on the transplanted extirpated organ; we studied the liver in situ.

EXPERIMENTAL METHOD

The mouse, with its liver exposed (the operation was performed without anesthesia), was covered by a screen with an opening situated over the liver.

The liver was irrigated with physiological saline at 38-41°C, and at the end of 10 min its radiation was tested; next the warm solution was replaced by cold (also physiological saline) at 6-9°C and 0-3°C, and the radition from the liver again tested. This test was carried out quickly, soon after the start of the irrigation with cold water, and lasted for 10 sec (exposure). The next exposure began 5 sec after the end of the previous one; it also lasted for 10 sec. If, for example, on the fourth exposure mitogenetic effect was found to be absent, then the next test (on the same animal) began 55 sec after the start of irrigation with cold physiological saline, and the exposure was increased to 15 sec, and so on.

Duration of degradation in the liver of the mouse. During cooling of the mouse liver to 6-9°C its degradation radiation continued for about 6 min, and in order to obtain any mitogenetic effect at the end of this period an exposure of 40 sec was required. After the lapse of 6 min no mitogenetic effect could be obtained with exposures of 45, 50, or even 55 sec. During cooling to 3.5-0°C the degradation radiation of the mouse liver lasted for about 7 min, while in order to obtain mitogenetic effect at the end of this period an exposure of 35 sec was necessary. In this series of experiments the limits of the duration of degradational radiation were not reached (Tables 1a and 1b).

TABLE 1a

Induction from the Liver of a Live Mouse During Irrigation of the Liver with Warm and Cold Physiological Saline (series I)

Exposure in seconds	Effect in % *	Temperature of solution in °C	Number of experiments
10	−1	39	3
40	−3	41-42	3
10 with an interval of 0 to 115**	37	6-9	10
15-25 with an interval of 30 to 250	42	5-8	5
30-40 with an interval of 255 to 380	36	7-9	5
45-55 with an interval of 380 to 435	4	8-9	5

* In this and subsequent tables: effect in % is calculated by the formula: $\frac{E-C}{C} \cdot 100$, where E is experiment, C is control.

** In this and subsequent tables the expression "exposure" 10 sec with an interval of 0 to 115 sec means that the given exposure may be taken anywhere during the time interval starting from the moment of irrigation with cold physiological saline to 115 sec from this zero.

TABLE 1b

Induction from the Liver of a Live Mouse During Irrigation of the Liver with Warm and Cold Physiological Saline (series II)

Exposure in seconds	Effect in %	Temperature of solution in °C	Number of experiments
5-10	2	40-41	6
15-20	−4	40-42	3
25-35	2	39-42	3
5-10 with an interval of 0 to 115	37	0-4	14
12-20 with an interval of 115 to 250	40	0	8
25-35 with an interval of 250 to 440	42	0	6

2. Onion layer. Duration of degradational radiation in relation to the initial temperature of the object.

In order to obtain degradational radiation the onion layer was pressed between two discs of ice (ice discs 2-3 mm thick transmit mitogenetic radiation). Control experiments in which blocks of yeast were placed on ice discs (without onion layers) and given exposures of 10, 15 and 20 sec showed that the ice discs did not affect the biodetector in the conditions of the experiment (mean effect 5%).

TABLE 2

Induction from the Layer of an Onion (Initial Temperature 9-12°C) During Cooling

Exposure in seconds	Effect in %	Number of experiments
10 with an interval of 0 to 40	42	8
15-20 with an interval of 40 to 65	3	7

Initial temperature of the onion layer 9-12°C. At experimental temperatures of 9-12°C the onion layer showed no obvious activity, and during irrigation with water at this temperature it did not emit radiation (exposures of 10, 15 and 25 sec). The degradation radiation of the onion layer causes well-marked mitogenetic effects during an exposure of 1) sec (mean effect 40%) and it continues for about 40 sec. At the end of this period no mitogenetic effect can be obtained even with twice the exposure, i. e., 20 sec (Table 2).

A temperature of 9-12°C is close to the temperature of 6-9°C at which degradational radiation was produced in the liver, and so we assumed that under these conditions the unbalanced constellations of the onion layer had undergone partial degradation, which would perhaps explain the short duration of its degradational radiation. In subsequent experiments before cooling the onion layer was irrigated with water at a temperature of 25-27°C for a period of 10 min.

Initial temperature of the onion layer 25-27°C. Control experiments to test the enzymatic mitogenetic radiation of the onion layer during irrigation with water at a temperature of 25°C showed the absence of mitogenetic effect during exposures of 5 to 25 sec [mean (of 6 experiments) effects 4%] and that it appeared only during exposures of 30-50 sec [mean (of 6 experiments) effects 42%]. Cooling the onion layer after 7-30 min irri-

TABLE 3

Induction from the Layer of an Onion (Initial Temperatures 25-27°C) During Cooling

Exposure in seconds	Effect in %	Number of experiments
10 with an interval of 30 to 105	46	12
10-30 with an interval of 105 to 135	1	6
40 with an interval of 105 to 145	37	1

TABLE 4

Exposure in seconds	Effects in %	Number of experiments
10 with an interval of 105 to 155	29	12
25 with an interval of 155 to 180	43	3
40 with an interval of 180 to 220	35	1

gation with water at a temperature of 25-27°C causes degradational radiation, detectable during an exposure of 10 sec and lasting about 100 sec. After the lapse of 100 sec, radiation is observed only with an exposure of 40 sec (Table 3).

Initial temperature of the onion layer 35-37°C. The results of these experiments are shown in Table 4.

Since the duration of the degradational radiation is increased from 40 to 220 sec by a change in the initial temperature of the onion layer from 9-12°C to 35-37°C, it follows that in relation to the influx of energy the unbalanced constellations accumulate different quantities – they have a different "capacity." Of course there must be a limiting "capacity" of these constellations, and when this is reached the surplus energy which is absorbed

may possibly cause disturbance of the constellations. I remember that A. and L. Gurvich were unable to obtain degradational radiation from the liver after irradiating the organ for 20 min with mitogenetic rays. It is possible that further increase of the initial temperature might also lead to disturbance of the unbalanced constellations. For this reason we warmed the onion layer to 43°C with water and tested it for degradational radiation. This temperature might, however, prove lethal for the object. Therefore, in the experiments in which the initial temperature of the onion layer was 43°C, we always set up a special control in which the onion layer was transferred after cooling to water at a temperature of 35-37°C and, after the lapse of 10 min, it underwent a second cooling. Degradational radiation would indicate that the onion layer was undamaged (Tables 5 and 6).

TABLE 5

Induction from the Layer of an Onion (Initial Temperature 43°C) During Cooling

Exposure in seconds	Effect in %	Number of experiments
5-10 with an interval of 30 to 40	3	4
5-10 with an interval of 95 to 105	−2	3
5-10 with an interval of 155 to 165	2	3

TABLE 6

Induction from the Layer of an Onion Cooled After Heating to 43°C, Cooling and Reheating to 35-37°C

Exposure in seconds	Effect in %	Number of experiments
10 with an interval of 120 to 130	35	5

Tables 5 and 6 show that cooling an onion layer previously heated to 43°C cannot cause degradational radiation, and that the changes brought about by heating in this way are easily reversible, since after transfer of the cooled onion layer into water at a temperature of 35-37°C, the appearance of degradational radiation could be caused by cooling it a second time.

Degradational radiation from an onion layer having previously been cooled once. The onion layer was irrigated with water at a temperature of 27°C for 10 min, cooled for 2.5-3 min, again irrigated with water at the same temperature for 10 min and again cooled (Table 7).

TABLE 7

Induction from the Layer of an Onion Heated to 27° for 10 Minutes, Cooled for 3 Minutes, Reheated to 27°C for 10 Minutes and Again Cooled

Test	Exposure in seconds	Effect in %	Number of experiments
During reheating	10	−2	3
During cooling for the second time	10	50	3

The result is perfectly clear: absence of radiation during reheating, with an exposure of 10 min and a well-marked mitogenetic effect during the subsequent recooling with the same exposure for 10 sec.

Analysis of the production of photons of degradational radiation. The experiments described and results previously obtained [5] showing that a cancer suppressor does not suppress degradational radiation permit an experimental solution of the problem whether degradational radiation arises only in consequence of large quanta of energy, formed by the recombination of free radicals or atoms and absorbed by the unbalanced molecular constellations, or whether it may arise as a consequence of summation of small quanta of energy by the constellations.

In order to solve this problem it was necessary to prevent recombination of free radicals or atoms by injecting into the onion layer a hydrolyzed cancer suppressor and to get rid of the large quanta of energy already absorbed by the molecular constellations by means of degradation. For this purpose the onion layer was heated

in water at a temperature of 25-26°C for 10 min, its enzymatic radiation tested, and then immersed in a solution of the hydrolyzed suppressor at a temperature of 25-26°C for 10 min, and its enzymatic radiation again tested. Next the onion layer was cooled and during cooling its degradational radiation was tested. Cooling lasted for 2.5-3 min in order to be sure that the degradational radiation had completely ceased. After cooling, the same onion layer was again immersed in the suppressor solution at a temperature of 25-26°C for 10 min and its enzymatic radiation was tested; it was then recooled (Table 8).

TABLE 8

Induction	Exposure in seconds	Effect in %	Number of experiments
From the onion layer after heating to 25-26°C for 10 min	50	31	2
From the same onion layer after staying for 10 min in a solution of a hydrolyzed cancer suppressor at a temperature of 25-26°C	50	−2	2
From the same onion layer during cooling	10	23	2
From the same onion layer after reimmersion for 10 min in the suppressor solution at a temperature of 25-26°C and subsequent cooling for 3 min	50	3	2
From the same onion layer during the second cooling	10	35	2

In order to make sure that this five-stage operation in itself did not affect the onion layer, we made a control series of experiments. The results of these experiments showed that immersion of the onion layer five times in water at a temperature of 27°C had no effect on the enzymatic radiation from the layer (mean effect 29%).

Table 8 indicates that penetration of the onion layer by the hydrolyzed suppressor brings the enzymatic radiation of the layer to an end but does not suppress its degradational radiation. During reimmersion of the layer in the suppressor solution enzymatic radiation is also absent. Subsequent recooling again causes the appearance of degradational radiation.

These facts lead us to conclude that large quanta of energy necessary for the production of degradational radiation may be produced not only on account of the energy of recombination of free radicals or atoms, arising rarely in the course of enzymatic processes, but also as a result of the summation of small quanta, possessing far less energy, for the direct formation of photons of degradational radiation.

SUMMARY

The duration of degradational radiation was studied, as well as the property of molecular constellations to accumulate energy and to sum up its low quantity. It was established that considerable quanta of energy required for the appearance of degradational radiation may appear not only due to energy of recombination of the free radicals of atoms (which is seldom and occurs in enzymatic processes), but also as a result of summation of the quanta which possess too little energy to form the photons of degradational radiation directly.

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