THE IMPORTANCE OF MITOGENETIC RAYS IN THE SYNTHESIS OF PEPTIDES IN THE LIVER

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(Received August 18, 1957. Presented by Active Member Acad. Med. Sci. USSR, V.N. Chernigovskii)

In 1937-1938 A.G. and L.D. Gurvich [1, 9] showed that during irradiation of mixed solutions of amino acids
with mitogenetic rays, compounds of relatively high molecular weight were formed, which, on digestion with
gastric juice, produced mitogenic rays of a spectral composition identical with that characteristic of the peptide
bond.

This work was of great importance in principle since it showed the possibility of in vitro synthesis of bio-
logically important compounds by a photochemical rather than an enzymic method. These workers put forward
the hypothesis that in the living organism, thanks to the mitogenetic system, peptide synthesis may take place by
a photochemical method in addition to and without the participation of enzymes.

A.G. and L.D. Gurvich [3] further showed the identity of the energy requirements for stimulation of peptide
synthesis and cellular division by mitogenetic rays: both peptide synthesis and cell division can be brought about
by any wavelength of the mitogenetic spectrum from 1900 to 2700 Å for irradiation in darkness and to 3260 Å for
irradiation in light or infrared radiation. This convinced these workers of the great biological importance of
the fact that the mitogenetic action of ultraviolet light begins with stimulation of peptide synthesis.

It must be pointed out that suppression of mitogenetic rays by the administration of a tumor-destroying
agent or of extinguishers of mitogenetic rays in living objects leads to a sharp fall in the number of dividing cells
[3, 4] and at the same time to marked vacuolization of the protoplasm of the majority of even the young cells
while in many cases the whole body of the cell appears as one continuous vacuole. This condition, analogous to
that observed in the rootlets of bean plants whose cotyledons have been cut off, is usually attributed to protein
starvation of the cells.

dispersion, making it possible to compile an atlas of the characteristic spectra of functional molecular
groups or, in some cases, of whole molecules of various organic compounds.

Because of its sensitivity, this method permits the analysis of extremely transient processes taking place in
vitro and in vivo as rare events. By means of this method E.A. Ternovskaya (cited in [11]) obtained more direct
experimental proof of peptide synthesis by mitogenetic irradiation of amino acid mixtures.

In 1953-1954 A.G. and A.A. Gurvich (cited in [11]) showed that in the dark, peptide synthesis in the leaves
of green plants takes place less intensively than in the light, since only in the light do mitogenetic rays arise in
them (according to N.M. Peredel'skaya [7]) in consequence of summation of the energy of the photons of visible
light to the level of ultraviolet radiation. In plants kept in the dark, peptide synthesis may be stimulated by irra-
diation with mitogenetic rays, but in plants grown in the light it is inhibited by suppression of mitogenetic rays.
by means of injection of the so-called extinguishers.

During prolonged action of extinguishers the diminution in protein synthesis is so considerable that growth of the experimental plants is retarded in comparison with controls. These results obtained by A.G. and A.A. Gurvich (cited in [11]) confirm the necessity of mitogenetic rays for peptide synthesis in the green leaves of plants.

In 1934 A.G. and L.D. Gurvich [2] found that in contrast to all other organs the liver and kidneys of animals on a normal diet do not produce mitogenetic rays. A.G. Gurvich expressed the view that as a result of the fact that processes of synthesis were predominant in the liver, it contains only an insignificant amount of the so-called fluorescents—low molecular compounds able to emit energy in the form of rays. High molecular compounds—proteins, glycogen and so on—do not fluoresce. Hence it followed in the first place that the liver of fasting animals in which processes of breakdown are predominant may possibly emit ultraviolet light, and in the second place that injection of fluorescents into normally fed animals should lead to emission of rays from their livers. Both these conclusions derived from A.G. Gurvich's hypothesis have been confirmed experimentally in work by E.A. Ternovskaya and V.F. Eremeev (cited in [11]).

The results of the investigations by E.A. Ternovskaya and V.F. Eremeev, and also reports in the literature on the synthesis of proteins in the liver of normally fed animals and of protein breakdown in the liver of fasting animals have enabled the study of the importance of mitogenetic rays in peptide synthesis in the liver to be undertaken.

It must be pointed out that the majority of authors [5, 6, 12, 13, 14, 15, 16] consider that the liver plays a great part in synthesis during protein metabolism, and assume that the liver has the power to accumulate proteins which are mobilized to meet the needs of the body during protein starvation more rapidly than proteins of other organs (especially in the first stages of starvation).

In this connection it might be supposed that in early stages of an animal's starvation the breakdown processes of protein substrate are still so ill-developed that the quantity of fluorescents formed in this way is not sufficient to reveal even threshold intensities of mitogenetic radiation. At the same time there is quite enough of them to reveal breakdown processes of protein substrate by the method of spectral analysis with selective dispersion.

If this hypothesis of A.G. Gurvich could be confirmed experimentally, an attempt might be made to irradiate the liver externally from some mitogenetic source and cause partial resynthesis of the protein substrate, which could be judged by the threshold exposures necessary to show selective dispersion of NH₂- and OH-groups, the amounts of which are increased during breakdown of protein substrate and decreased during its resynthesis. This investigation forms the content of the present paper.

**EXPERIMENTAL METHOD**

White mice were kept for 18 to 20 hours on a fixed diet (millet, white bread and milk). An excess of food was given to the animals. At the conclusion of this period they were totally fasted. Fasting lasted from 3 hours 30 minutes to 5 hours 30 minutes.

It was first established that radiation appeared in the liver during starvation of the animal for 5 to 5 1/2 hours.

Further experiments were performed in accordance with the following scheme. After fasting for four hours it was checked whether there was spontaneous radiation in the liver of the animal, and the selective dispersion spectrum of the amino groups was taken. Next the liver was irradiated for 15-30 minutes with mitogenetic rays from a source of radiation and the selective dispersion spectrum of the amino groups of the protein substrate again taken at different exposures. In this way, in the first series of experiments the selective dispersion spectrum was taken from the same aspect (ventral) as the lobe of the liver irradiated; in the second series of experiments, from the opposite aspect, i.e., the liver was irradiated on the dorsal aspect and the spectrum taken from the ventral aspect.

In order to obtain full confirmation that all the manipulations carried out on the liver were not affecting its condition, special control experiments were set up in which everything was done to the liver just as has been described, but it was not irradiated from a source of mitogenetic rays.