FUNCTIONAL APPROACH TO THE STUDY OF ANIMALS POPULATIONS (RODENTS - ADAPTATIONS TO HARMFUL FACTORS).

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Radiosensitivity problem is the part of problem of biological variability and physiological individuality, adaptation and total adaptability. But ionizing radiation influence prognosis is not beyond the theoretical studies yet [1, 2] and hasn't been developed even for external irradiation (acute and chronic) and known dose loads. Information concerning the responses of variety of organisms to radiation exposure is required to make an assessment of potential environmental impact. There are many data about a various small mammals' radioresistance, but all of them were fulfilled without the account of the functional status of animals.

The possibility of two alternative pathways of growth and development regularly realized during ontogenesis (single-phase and biphase growth) was demonstrated in a natural bank vole (Clethrionomys glareolus Screb.) population (South Urals, South taiga subzone). The functional approach, offered by Olenev [3, 4] and used in the zoological investigations, is based upon the functional status (the functional condition, associated with the specificity of growth, development, reproductive condition and succession in time). It has been suggested that three Physiological Functional Groups (PFG) should be distinguished.

FIRST PATHWAY OF ONTOGENETIC DEVELOPMENT. (corresponding to PFG 3).Youngs of year breeding during their Year of Birth are characterized by monophasic rapid growth, reaching an average body weight of 25 g, and enter breeding. Initial stage of formation of true roots started at 65-75 days of age [4]. The high level of metabolic processes. Rapid aging (by our data on age changes in teeth), life span is 3-5 months. These animals serve to provide the increase in numbers during their year of birth.

SECOND PATHWAY OF ONTOGENETIC DEVELOPMENT.(corresponding to PFG 2). Youngs of the year, which do not breed during the Year of Birth are characterized by biphase growth. At approximately one month of age, at a body weight of 16-18 g, growth is suspended, and the first phase of growth is concluded. The initial stage of formation of true roots in them is noted at age of 120-130 days. Activity of metabolic processes is reduced. Lifespan the Youngs of the year (with regard the second phase of growth) is 13-14 months. Aging is delayed as compared to PFG 3 by almost two times. The spring period of "conservation" is concluded by short-term growth and maturation within the course of two-three weeks, and body weight reaches 24-27 g during this. Almost all animals. which overwintered, mature. Activated processes of metabolism are similar in level to those for PFG 3 individuals. although according to absolute age animals are much older than representatives of PFG 3.

It is known that radioresistance to a considerable extent depends on previous to irradiation functional organism condition, the most significant indices of which are CNS and immune system condition, metabolism and energy processes level and also hormonal status of the organism. So the study aimed to reveal the peculiarities of the PFG 2 and PFG 3 radioresistance.

MATERIAL AND METHODS

The laboratory experiments were carried out it the two intrapopulational functional groups of bank voles (Cl. glareolus), captured from the natural environment in Southern Urals. Voles were subjected to acute total gamma-irradiation ^{137}Cs in the range 9,0 - 15,5 Gy (exposure rate of 110 s Gy/min). The lethality, average lifespan and effects of radiation on the haemopoietic system (bone marrow from femur and blood) were estimated after the dose 12.7 Gy, chosen so that it would cause the enough high level mortality of animals. The quantity of leucocytes and granulocytes of bone marrow were determined at various postirradiation intervals on 1, 4, 8, 16, 30 days from 7 different voles in each functional groupings. These experimental values were also obtained from 10 unirradiated control voles of the same grouping for making a comparison. A total of 307 individuals was utilized in this study: 177 animals from PFG 2, 130 from PFG 3. All hematological tests were measured by the standard micromethods. All animals were maintained in our laboratory conditions under the constant temperature and humidity during 30 days observation period.

RESULTS AND DISCUSSION

LETHALITY.

It is apparent from Table 1 that PFG 2 voles are more radioresistance than those of PFG 3 (LD 50/30 -13,2 ± 0,2 Gy and 12,7 ± 0,2 Gy, relatively, p≤0,05) [5]. It should be noted, the range of doses when the death of PFG 2 animals was observed is 12,7 - 15,5 Gy, while for PFG 3 voles is 11,0 - 14,0 Gy. The mortality of the breeding year's youngs were almost in 3 time greater than the nonbreeding year's young after the exposure by the dose 12.7 Gy.

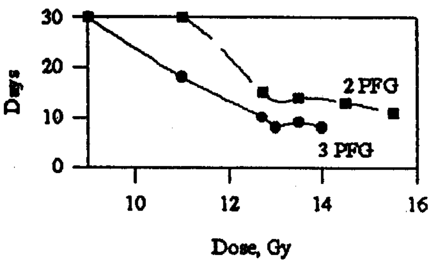
AVERAGE LIFESPAN.

The lifespan from the moment of exposures to the death during 30 days of observation is a criterion of radiation effect' assessment [6]..It is well known that this indicator is inversely proportional to quantity the dose. This seems to be supported by the data from Tabl.1 which demonstrated that after irradiation by dose 12,7 Gy the lifespan of PFG-3 voles is 9.8 days and period of death with 4-th to 12-th days whereas the lifespan of PFG 2 animals is 13,5 days (the difference is significant) and period of lethality with 11-th to 18-th postirradiation days. Dose 14,0 Gy causes 100% mortality of animals PFG 3, while the 100% level of lethality for voles PFG 2 are registered after dose 15,5 Gy (Fig.1).

Tab. 1. Lethality and average lifespan of different PFG voles, subjected to irradiation by 12.7 Gy.

Parameters	PFG 2	PFG 3
Number of animals	34	41
Number of dead animals	6	22
Lethality, (%)	17.6	53
Average lifespan	13.5±0.7	9.8±1.0

Fig. 1 The relationship between dose and average lifespan of intrapopulational bank voles groupings.



A features of the of radiation sickness among animals different functional groupings are noted. The intestinal symptoms such as diminished food and water intake, diarrhoea, loss of fluids, and another clinics manifestation, such as a decreased activity, conjunctivitis were expressed more stronger for animals PFG 3. has already been noted, part of voles PFG 3 were died in early period (within the first 7 days following exposure). It may be believed, that the main couse of their lethality is the damage to the gastro-intestinal tract. But animals PFG 2, were died in more late period. Therefore, one can suppose, that their death was occured by the bone marrow syndrome.

REACTION OF THE HAEMOPOIETIC SYSTEM:

Radioresistance of mammals depend upon the radiation damage of radiosensitive systems, such as the haemopoietic system and the gastro-intestinal mucosa. The stem cells are most radiosensitive and thus predominately influence radiation response. Symptoms occur when lack of replacement of end cells occur [7]. The kinetic of a leucocytes and bone marrow cells quantity, demonstrated in the Fig.2, shows the essential differences between the two investigated groupings by the depth of parameters decreasing. The rate and the level of recovery of the nonbreeding year's youngs were also significantly greather. Our experimental data correspond to a literature ones that cells systems, undergoing to continual renewal or rapid growth, are likely to exhibit the greatest radiosensitivity . It can assume the radioresistance of the nonbreeding part of a population are conditioned by minimizing of a metabolism processes and a reducing of the energy supplying.

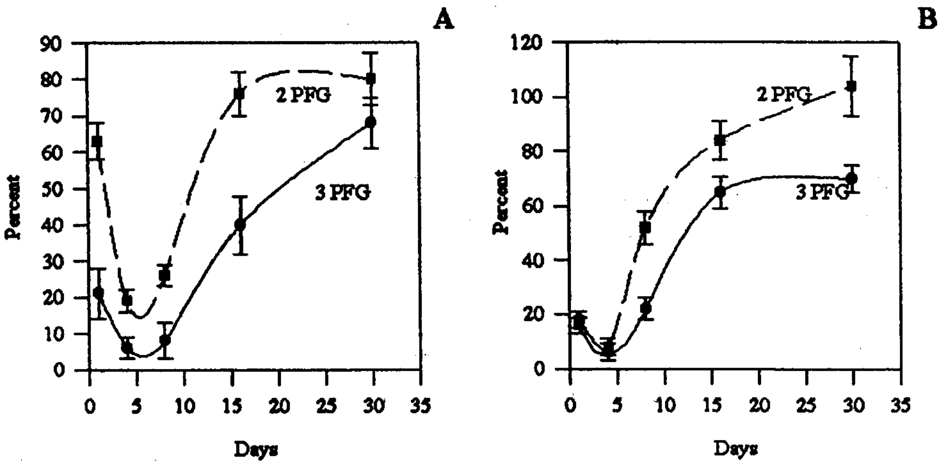


Fig. 2 Comparative haemopoietic cytokinetic in two intrapopulational functional groupings of bank voles exposed to the dose 12.7 Gy. A - LEUCOCYTES, B - BONE MARROW CELLS.

CONCLUSIONS

1. Specimens of the same absolute age, but of a different functional status , are differed essentially in the response to the radiation' action by the next criteria: LD50/30, the average lifespan, the reaction of the haemopoietic system. In the natural environment (exemplified on a rodents populations) it can change the relation between breeding and nonbreeding parts of the population and, thus, its density.

2. It seems reasonable to apply the functional approach in the practice of radioecological investigations. It permits substantial reduction of errors and provides a more precise methodological basis for analyzing of the radioresistance of a natural animals populations, for a conducting of experimental investigations and also for the health protection.

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