DNA-synthesizing and dividing hepatocytes, but third, the degree of their involvement in this process differs. It was suggested previously that hepatocytes are equal in their proliferative potential, on the basis of their random distribution in the liver lobule [3].

Data on the higher mitotic activity of hepatocytes in zones 1 and 2 of the lobule at the time of its maximum in the circadian rhythm are in agreement with results obtained during the study of the regenerating liver in the period of maximal mitotic activity, when MI_3 was lower 24, 28, and 32 h after hepatectomy, than MI_1 and MI_2 [2].

It is also an interesting fact that in the period of decline of GRI in the rhythm, the number of DNA-syntheizing cells in the central zone remained just as high as during acrophase of the rhythm, but the number of mitoses fell equally sharply in all zones of the lobule. It can be tentatively suggested that a raised value of RI_3 is connected with the need to make good the number of polyploid cells, which are most numerous in the central zone [9].

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EFFECT OF ANTIOXIDANTS ON FREE-RADICAL OXIDATION OF LIPIDS IN TESTS OF RATS OF DIFFERENT AGES AND ON REPRODUCTIVE CAPACITY IN CHRONIC POLYANTIOXIDANT INSUFFICIENCY

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KEY WORDS: reproductive system; lipid peroxidation; aging; antioxidants.

The development of ideas on the role of free radicals in aging has led to the enunciation of the free-radical theory of aging [6-9]. Keeping animals on a diet deficient in bioantioxidants caused the development of changes similar to those observed during aging: lipofuscin accumulates, differentiation of the spermatogenic epithelium is disturbed, interstitial connective tissue proliferates in the tests, and atherosclerotic changes appear in the blood vessel walls [3].

In the investigation described below biochemical parameters of free-radical oxidation (FRO) of lipids were studied in the tests of rats of different ages and with chronic polyantioxidant insufficiency, the reproductive capacity of rats was investigated under conditions of excessive FRO of lipids, and the protective action of a combination of antioxidants (AO) was examined.

EXPERIMENTAL METHOD

Wistar rats of three age groups were used: sexually mature (6.5 months), elderly (18.5 months), and old (28.5 months). Animals in each age group were divided into three series:

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TABLE 1. Effect of AO Complex on Biochemical Parameters in Rats of Different Ages (in months) with Chronic Polyantioxidant Insufficiency (M ± m)

Parameter	Age of animals, months								
	6,5			18,5			28,5		
	A	B	C	A	B	C	A	B	C
Acyl hydroperoxides, extinction units/ml	0,6±0,03	2,26±0,21*	1,24±0,02**	1,08±0,08	1,75±0,15*	1,14±0,07**	1,64±0,13	2,33±0,45*	1,45±0,18**
Peroxide hemolysis of erythrocytes, %	7,4±0,8	20,8±1,1*	6,3±0,5**	17,9±0,6	25,0±1,1*	12,6±1,5**	24,9±0,8	25,3±2,3	15,6±1,4**
Ascorbic acid, mmoles/kg: Reduced	3,1±0,3	2,13±0,06*	2,32±0,13	2,08±0,14	1,92±0,14	2,22±0,14**	1,24±0,12	1,12±0,03*	1,63±0,14
Total	1,02±0,01	0,77±0,04*	1,04±0,04**	0,86±0,08	1,61±0,03*	0,93±0,06**	0,77±0,03	0,55±0,05*	0,84±0,05**

Legend. Here and in Table 2: *) differences statistically significant relative to intact animals; **) differences relative to animals with chronic polyantioxidant insufficant. A, B, and C) – animals of series I, II, and III, respectively.

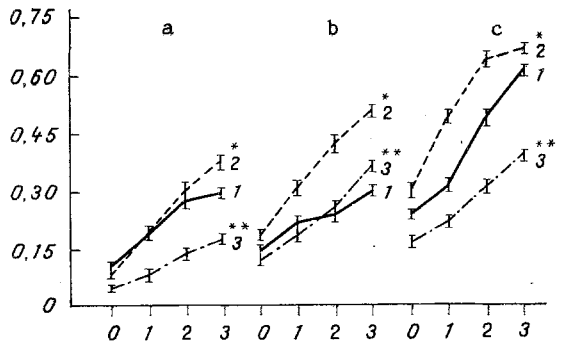

Fig. 1. Accumulation of MDA in the testes with time. 1) Intact rats; 2) rats with chronic polyantioxidant insufficiency; 3) rats with chronic polyantioxidant insufficiency, receiving the AO complex. A, B, and C) Animals aged 6.5, 18.5, and 28.5 months, respectively. *) Differences statistically significant compared with series I;**) the same, compared with series II. Ordinate, MDA level (in extinction units per gram tissue); abscissa, incubation time (in h).

I) intact (five sexually mature, seven elderly, and old rats, respectively); rats of series II were kept on an antioxidant-free diet, reproducing the condition of chronic polyantioxidant insufficiency (five mature, seven elderly, and four old rats); rats of series III (five mature, 12 elderly, and five old) were kept under the same conditions as the animals of series II, but were given a combination of AO daily with their diet. The combination consisted of tocopherol acetate, ascorbate, rutin, thiol AO, and a peroxidase inducer, in a daily dose of 86 mg/kg body weight. Chronic polyantioxidant insufficiency was produced in rats kept on a seminatural antioxidant-free diet for 100 days [3]. Toward the end of the experiment, parameters reflecting the level of FRO of lipids and the antioxidant intake were investigated in the blood and tissues: the serum concentration of acyl hydroperoxides spectrophotometrically by measuring absorbance at 232 nm [2], the degree of resistance of the erythrocyte membranes to spontaneous hemolysis [10]. The level of accumulation of malonic dialdehyde (MDA) in the tissues of the testes was studied by the thiobarbiturate method [1], with incubation for 3 h and constant aeration of the homogenate, and concentrations of ascorbic acid fractions were determined [5]. The reproductive capacity of the male rats was assessed [4] in 15 sexually mature animals, including five intact rats and 10 rats on an antioxidant-free diet, inducing lipid FRO, of which five rats received the AO complex. Each male was kept with five intact sexually mature females for 7 days. Some of the females were autopsied on the 21st day of pregnancy under hexobarbital anesthesia (50 mg/kg body weight) and the number of corpora lutea (potential fertility) and the number of fetuses (actual fertility) counted. The embryonic mortality was determined in percent as the ratio between these values.

EXPERIMENTAL RESULTS

Keeping rats of different age groups on an antioxidant-free diet led to intensification of lipid FRO, which was more marked in the old animals; the level of acyl hydroperoxides in the blood serum rose in rats of all age groups. Peroxide hemolysis of erythrocytes rose significantly compared with intact animals (Table 1). Lipid FRO was intensified most strongly in the testes: in the course of the experiment the MDA level exceeded that in intact animals. The MDA level rose most rapidly in old rats (Fig. 1). A decrease was observed in the supply of ascorbic acid, especially its reduced form, to the testes in rats of the mature and old age groups; this parameter showed no significant change in rats of the intermediate, elderly group. Administration of the AO complex to rats with chronic polyantioxidant insufficiency inhibited lipid FRO (Table 1).

The study of the reproductive capacity of the mature males with chronic polyantioxidant insuffiency showed that despite their normal libido sexualis, their fertility was appreciably reduced. Embryonic mortality was twice as high in females paired with these males (Table 2).

In females paired with males receiving the AO complex together with an antioxidant-free diet the number of corpora lutea, the number of fetuses, and the embryonic mortality were virtually indistinguishable from the corresponding parameters in intact animals.

The results are evidence that products of lipid FRO may be involved in disturbance of reproductive function in males. The need to transmit intact hereditary material to the progeny assumes the presence of an effective system of antioxidant protection of the spermatogenic epithelium against exposure to products of excessive lipid FRO. This hypothesis also is confirmed by the marked protective action of the AO complex as shown by biochemical and functional parameters. By making good components of the physiological antioxidant system of the spermatogenic epithelium, the preparation evidently reduced the damaging action of FRO products.

TABLE 2. Parameters of Reproductive Function in Female Rats (M ± m)

Parameter	A	B	C
Number of corpora lutea	13,0±0,65	11,0±0,7	11,8±0,8
Number of fetuses	11,9±0,95	8,8±1,2*	10,6±1,1**
Total embryonic mortality, %	8,5±1,2	20,0±1,4*	10,2±1,3**

The results may serve as the basis for the use of AO preparations as agents normalizing reproductive function in males during a period of low intake and increased utilization of alimentary AO (winter and spring, a stress situation, limitation of physical mobility, a high background level of radioactivity, etc.).

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EFFECT OF IMMOBILIZATION STRESS ON PITUITARY GONADOTROPHIC FUNCTION IN MALE *Papio hamadryas*

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KEY WORDS: immobilization stress; luteinizing hormone; testosterone; monkeys; castration.

Exposure to stress causes a fall of the tesosterone level in peripheral blood of man and various species of animals [1-5, 10, 15]. Changes in the testosterone concentration are associated with depression of the secretory activity of the testes, and both with changes in peripheral metabolism, for the rate of metabolic clearance of testosterone is unchanged during stress [8].

A key role in the maintenance of the endocrine activity of the testes is played by pituitary luteinizing hormone (LH). Information on its time course during exposure to

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