MR 2673

AUTHORS: Volkova AP, Fukalova PP:

DATE: 1974

TITLE: Changes in certain protective reactions of an organism under the influence of SW in experimental and industrial conditions, in Gordon ZV (ed): Biological Effects of Radiofrequency Electromagnetic Fields, JPRS 63321.

SOURCE: Arlington, VA, US Joint Publications Research Service, 30 Oct 1974, pp 168-74

MAIN SUBJECT HEADING:

AN	HU	AT	IH	M
ANALYTICS	HUMAN EFFECTS	ANIMAL TOXICITY	WORKPLACE PRACTICES-ENGINEERING CONTROLS	MISCELLANEOUS

SECONDARY SUBJECT HEADINGS: AN HU AT IH M

Physical/Chemical Properties

Review

Animal Toxicology

Non-occupational Human Exposure

Occupational Exposure

Epidemiology

Standards

Manufacturing

Uses

Reactions

Sampling/Analytical Methods

Reported Ambient Levels

Measured Methods

Work Practices

Engineering Controls

Biological Monitoring

Methods of Analysis

Treatment

Transportation/Handling/Storage/Labelling

MR 2673

UDC 614.87:537.868.029.64

CHANGES IN CERTAIN PROTECTIVE REACTIONS OF AN ORGANISM UNDER THE INFLUENCE OF SW IN EXPERIMENTAL AND INDUSTRIAL CONDITIONS

Moscow O BIOLOGICHESKOM DEYSTVII ELEKTROMAGNITNYKH POLEY RADIOCHASTOT in Russian 1973 pp 119-123

[Article by A.P. Volkova and P.P. Fukalova]

[Text] Studies have been conducted on the effects of short waves (SW) on changes in the immunobiological reactivity of experimental animals, and of people, under industrial conditions.

The present study dealt with investigations on the effects of SW on the state of natural immunity of experimental animals and of people under industrial conditions.

In laboratory experiments, one group of outbred white rats were exposed to 14.88 MHz SW with intensity of 2250 V/m (threshold nonthermogenic intensity) for one hour. A second group of animals were irradiated for four hours with an intensity of 100 V/m. A third group served as controls. The state of the natural immunity was evaluated in terms of the phagocytic activity of blood neutrophils [A.P. Volkova and V.I. Ternov, 1965 and plasma bacteriocidal properties [O.G. Alekseyeva, 1961] As the test microbe we employed a 24 hour agar culture of E. coli strain 675 as a one billion + suspension. At the end of the experiment the animals were infected with this microbial strain, and the nature of the inflammatory reaction was used to evaluate the state of natural resistance.

The resultant data are presented in Figures 1, 2 and 3 (the indices were calculated as a percentage of the control data taken as 100).

SW resulted in marked activation of the phagocytic activity of neutrophils. These changes were more pronounced when irradiation was conducted with 100 V/m intensity. The index of digestion in the second group of animals increased threefold ($P < 0.01$). By the second month, activation was replaced by sharp inhibition, and again the lowest values for this index were encountered when low intensity -- 100 V/m -- was employed (0.14 ± 0.01 against 0.5 ± 0.03 in the control group). At later stages, changes in the phagocytic activity of neutrophils depended on the intensity of radiation. Over a period of three to ten months, the animals that had been exposed to irradiation at an intensity of 2,250 V/m evidenced extremely low phagocytic activity. At the end of the experiment the phagocytic activity of this group had decreased by 56% ($0.16 + 0.4$ and 0.36 ± 0.05 in the control); the second group demonstrated a decrease in phagocytosis by 25% (0.27 ± 0.04).

Plasma bacteriocidal activity in this and in the second group, was at a low level beginning with the second month. Nevertheless, such a distinct linear relationship between the bacteriocidal activity and the intensity was not noted, as was the case in studies on phagocytosis. Only at the end of the experiment did the activity in the first group decrease by 11%, while in the second group, it was at the same level as the control value.

Evaluation of the animals a month and a half after irradiation had been terminated, showed that the phagocytic activity was at a low level. In the first and the second group, it stood at 0.3 ± 0.02, while in the controls, it was 0.5 ± 0.09 ($0.05 < P > 0.02$). It is obvious that recovery of phagocytic activity did not occur. Bacteriocidal properties of plasma in both cases did not differ from the control data.

Within nine months of the termination of the experiment, the experimental and control animals were infected with the strain of E. coli which had been used for the phagocytic studies. E. coli, in an amount of 1.4-1.6 billion microbial cells in a volume of 0.1 ml physiological solution, administered beneath the aponeurosis of the foot of a posterior extremity. The degree of inflammation was evaluated in terms of a scale, and the observations were conducted for a period of two weeks. Figure 3 illustrates the course of the inflammatory process. In both the first and the second groups the nature of the reaction differed significantly from the reaction in the control animals. The course of the inflammatory reaction was more pronounced in those rats that had been exposed to more intense irradiation. Thus, in that group four days after infection, the degree of the inflammatory reaction was evaluated as 6.6 ± 0.5 units, while in animals exposed to 100 V/m, it was 5.0 ± 0.01, and in the control animals, it was 4.0 ± 0.3; at the end of the period of observation, the corresponding values were 1.2 ± 0.02, 0.5 ± 0.001, and in the control, 0.2 ± 0.01.

Differences in the nature of the inflammatory response in the first and the second group, in comparison with the control group, were statistically significant ($P < 0.01$).

Therefore, our experiments have demonstrated that prolonged exposure over a ten month period to SW electromagnetic energy at an intensity of 2,250 V/m for one hour, or 100 V/m for four hours, leads to a change in natural immunity which is more pronounced when the higher intensity is employed.

Studies on the effects of SW on the protective forces of man were conducted under industrial conditions.

Four stations are in operation at the radio center where we conducted our investigations. At three of these stations, after the safety measures recommended by the Institute of Labor Hygiene and Occupational Diseases of the Academy of Medical Sciences USSR had been implemented, the intensity of irradiation did not exceed the maximum permissible level (up to 20 V/m). At the fourth station where the safety recommendations had not yet been implemented, the field intensities significantly exceeded the maximum permissible levels, and amounted to scores of V/m and greater.

The studies were conducted on 123 clinically healthy individuals (radio engineers and radio technicians) who serviced the radio transmitters.

All of the individuals in the study live in the same residential area and enjoy approximately the same living conditions.

In our investigation, in addition to a study of the phagocytic and bacteriocidal function of the blood, we studied the numbers and the nature of the autoflora in the mouth cavity [O.G. Alekseyeva, 1965], as well as the bacteriocidal properties of the skin [N.N. Klemperskaya and G.A. Shal'nova, 1966]. The results of these observations showed that prolonged exposure to SW electromagnetic energy elicits certain changes in the state of some of the protective factors of the organism (Figure 4). Thus, employees at the fourth station (54 men) who were exposed to intensities which exceeded the maximum permissible levels (shaded columns on Figure 4) evidenced changes in the phagocytic activity and the numbers of autoflora in the mouth cavity. The number of microbes on the mucous membrane of the mouth cavity was, on the average, 1,791 ± 109, the phagocytic activity was 0.3 ± 0.03, the bacteriocidal activity of the skin was 70 ± 7.5, and the bacteriocidal property of the plasma was 33 ± 1.7. Therefore, work with SW emitters at intensities exceeding the maximum permissible levels, leads to a sharp (two-fold) inhibition of the phagocytic activity of neutrophils, and a high (four-fold) seeding of the mucous membrane of the mouth with autoflora microbes, in comparison with normal indices [M.N. Klemperskaya and G.A. Shal'nova, 1966]. Consequently, the same trend in changes was observed as was seen with the experimental animals, namely, inhibition of certain factors of natural immunity.

Among the workers at the three stations (69 men) where the levels of irradiation did not exceed maximum permissible levels, the indices under study were virtually within the normal range; the autoflora counts were 469 ± 65, the phagocytic activity was 0.7 ± 0.05, skin bacteriocidal activity was 73 ± 5.9, and plasma bacteriocidal activity was 27 ± 1.2 (unshaded columns in Figure 4). These findings indicate that it is possible to use immunobiological methods under industrial conditions in order to evaluate the effectiveness of sanitary and hygienic measures.

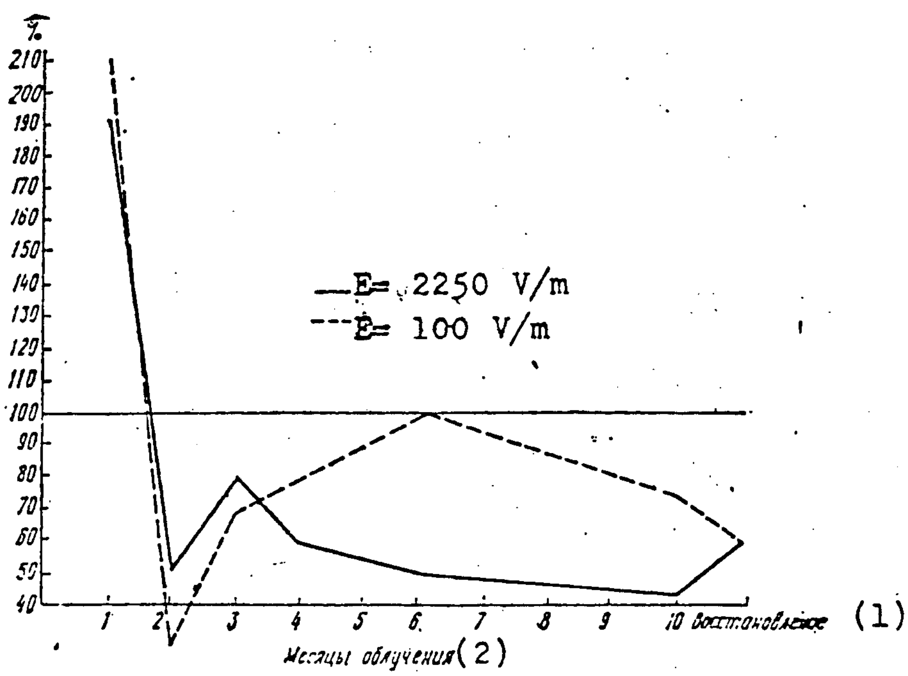

Figure 1. Changes in the Phagocytic Response Under the Influence of the SW Band of Different Intensities

Key: 1. Recovery
2. Irradiation, months

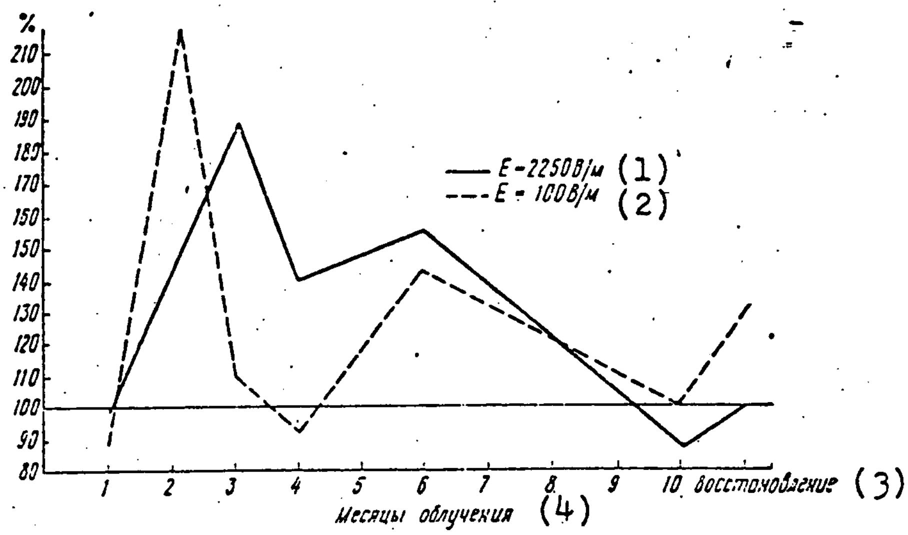

Figure 2. Changes in the Bacteriocidal Function of Blood Plasma Under the Influence of Various Intensities of the SW Band

Key:
1. E = 2250 V/m
2. E = 100 V/m
3. Recovery
4. Irradiation, months

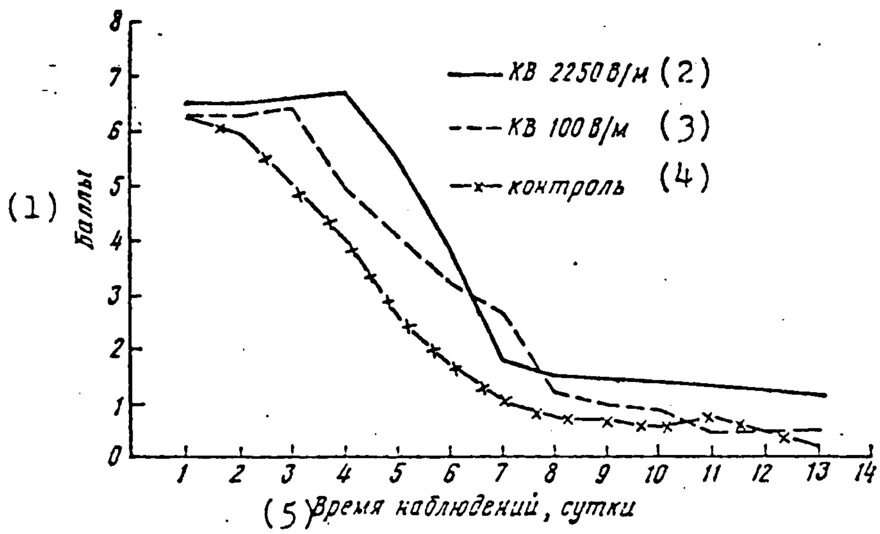

Figure 3. Inflammatory Response in Animals Exposed to Different Intensities of the SW Band

Key:
1. Scale
2. SW 2250 V/m
3. SW 100 V/m
4. Control
5. Observation time, days

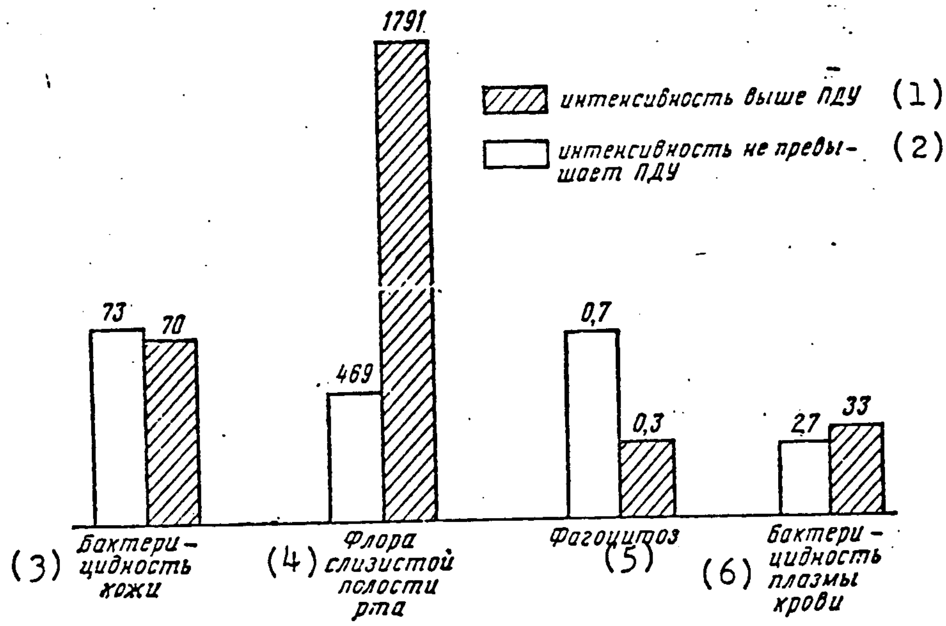

Figure 4. The State of Barrier Functions in Workers at Radio Transmission Centers

Key:
1. Intendisty above maximum permissible level
2. Intensity not exceeding maximum permissible level
3. Skin bacteriocidal activity
4. Flora of the mouth mucous membrane
5. Phagocytosis
6. Blood plasma bacteriocidal activity