Using millimeter Waves for Treating Cancer Diseases

A. ROTARU, Gh. TÂBÂRNĂ, V. JOVMIR, I. COJOCARU, A. SAULEA, Dr. ROTARU.
Mail correspondent author: r.anatol@yahoo.com, cojocaruion2007@gmail.com
State University of Medicine and Pharmacy "Nicolae Testemiţanu", Chişinău, Moldova,
Department of Human Physiology and Biophysics

***Abstract* — It is exposed using of millimeter waves in the treatment of cancer. This is due to the fact that nowadays one of the most important trends in modern medical biology is the study of non-thermal effects of low-intensity electromagnetic radiation application. One of the most important and urgent problems of modern medicine is to increase the efficiency of cancer treatment. It is known that disorders of various regulatory systems of the body and failure in tissue homeostasis are linked to tumor process and can be exacerbated by the use of intensive courses of chemo and radiation therapy, which leads to a decrease in anti-tumor resistivity.**

Cancer treatment is one on the main problems of modern medicine and a lot of research was done around this subject.

One of the most important and urgent problems of modern medicine is to increase the effectiveness of cancer treatment. Abnormalities in various regulatory systems of the body exactly as the failure of tissue homeostasis mechanisms are linked to tumor process and can be exacerbated by the use of intensive courses of chemo and radiation therapy, which may lead to an even greater reduction in anti-resistivity [1].

In modern oncology a specific attention given to areas where the methodology is focused on the mobilization of natural protective mechanisms [2-4].

Developing effective methods of using the latest physical technologies as mono and combined therapy of cancer treatment represents an urgent problem of modern medicine. Widespread use of extremely high frequency terahertz and infrared low-power radiation is due to the fundamental role of weak and super weak electromagnetic interactions in the functioning of medical and biological systems of different hierarchical levels.

At the present stage of experimental and clinical oncology is widely and successfully used low-intensity electromagnetic radiation of different frequency bands: ultra-low microwave extremely high frequency, optical. All these radiations lead to an increase in the non-specific body anti-resistivity and reduce the toxic effects of radiation and chemotherapy.

In paper [5] is described the study that was undertaken to examine whether millimeter electromagnetic waves (MMWs) irradiation (42.2 GHz) can inhibit tumor metastasis enhanced by cyclophosphamide (CPA); an anticancer drug. MMWs were produced with â Russian-made YAV-1 generator. Peak SAR and incident power density were measured as 730 ± 100 W/kg and 36.5 ±5 mW/cm2, respectively.

Tumor metastasis was evaluated in C57BL/6 mice, an experimental murine model commonly used for metastatic melanoma. On day 2, all animals were injected, through a tail vein, with B16F10 melanoma cells, a tumor cell line syngeneic to C57BL/6 mice. Tumor colonies in lungs were counted 2 weeks following inoculation. CPA caused a marked enhancement in tumor metastases (fivefold), which was significantly reduced when CPA-treated animals were irradiated with MMWs. Millimeter waves also increased NK cell activity suppressed by CPA, suggesting that a reduction in tumor metastasis by MMWs is mediated through activation of NK cells.

In this research [6] is evaluated quantitatively the ability of MMWT to influence tumor growth and to assess whether endogenous opioids are involved. The murine experimental model of B16 FIO melanoma subcutaneous growth was used. MMWT characteristics were: frequency, 61.22 GHz; average incident power density, 13.3 x 10 W/cm^2; single exposure duration, 15 min; and exposure area, nose. Naloxone (1 mg/kg. intraperitoneally, 30 min prior to MMWT) was used as anonspecificblocker of opioidreceptors. Five daily MMW exposures, if applied starting at die fifth day following B16 melanoma cell injection, suppressed subcutaneous tumor growth. It was concluded that MMWT' has an anticancer therapeutic potenţial and that endogenous opioids are involved in MMWT-induced suppression of melanoma growth in mice.

In [7] is investigated whether millimeter wave (MMW) therapy can increase the efficacy of cyclophosphamide (CPA), a commonly used anti-cancer drug. The effect of combined MMW-CPA treatment on melanoma growth was compared to CPA treatment alone in a murine model. MMWs were produced with a Russian made YAV-l generator. The device produced 42.2 + 0.2 GHz modulated wave radiation through a 10x20 mm rectangular output horn. The animals, were irradiated on the nasal area. Peak SAR and incident power density were measured as 730 ± 100 W/kg and 36.5 ± 5 raW/cm2, respectively. The maximum skin surface temperature elevation measured at the end of 30 min irradiation was 1.5 °C. Melanoma cells (0.2 x 106) were implanted subcutaneously into the left fiank of mice on day 1 of the experiment.

On days 4 - 8, CPA was administered intraperitoneally (30 mg/kg/day). MMW irradiation was applied concurrently with, prior to or following CPA administration. A significant reduction ($P < .05$) in tumor growth was observed with CPA treatment, but MMW

irradiation did not provide additional therapeutic benefit as compared to CPA alone. Similar results were obtained when MMW irradiation was applied both prior to and following CPA treatment.

In [8], electromagnetic millimeter waves (MM) (λ = 1 to 10 mm) correspond to the extremely high frequency (EHF) band. In those days, scientist all over the world discussed possible application of electromagnetic waves in non-traditional fields – such as biology, medicine and some others.

The point is that MM-wave radiation is virtually absent in natural conditions. This is due to its strong absorption by the Earth's atmosphere: MM waves are absorbed eagerly by water vapor. Application of Low intensity MM-wave Radiation in Medicine.

In the early 1970's academician Devyatkov initiated a program of clinical evaluation of MM waves in respect of USSR and RSFSR. Ministries of Health. The MM-wave technique was treated in more than 60 clinics, including large medical centers, such as the All-Union Cancer Research Center of the Russian Academy of Medical Sciences, the Central Research Institute for Traumatology and Orthopedics of the Russian Federation Ministry of Health, the P.A. Hertsen Moscow Cancer Research Institute, as well as clinics affiliated with the State Medical University, Moscow Medical Academy and Moscow State Institute for Dentistry. The results obtained provided evidence for high efficiency of

In [9], clinical evaluation of low-intensity MM-wave radiation and development of therapeutic techniques for cancer treatment have been carried out since 1980. These investigations were pursued at the P.A. Gertsen Moscow Cancer Research Institute. They were made in patients with mammary gland cancer. The combined therapy (chemotherapy and MM wave therapy before, during and after chemotherapy) was used (Pletnev, 1989-1995).

When the combined treatment was finished completely, 95,1% of the patients exhibited a satisfactory general state (without blood-circulation stimulants). When the chemotherapy course (without MM-wave irradiation) was finished, 74,2% of patients revealed an unsatisfactory general state as well as a reduced leukocyte count of blood. This occurred in spite of the fact that the patients received blood transfusion and blood circulation stimulants.

The ability of MM-waves to normalize leukocyte count was investigated in patients with leukopenia. The investigation was made in 900 patients whose initial leukocyte count of blood was less than 3000 (from 2300 to 2700). A course of treatment lasted for 12 days. The sessions were administered daily. After the cure, leukocyte count of blood was normalized in 80% of the patients. This allowed the patients to undergo a complete course of chemotherapy. The proliferative activity of the bone-marrow was found to grow 4 to 5 days after the MM-wave therapy commencement.

In [10] represents a review of the literature dealing with application of low intensity electromagnetic waves of millimeter band in experimental and clinical oncology.

In [11] was evaluated the electroencephalography (EEG) of humans and laboratory animals during and after Radiofrequency (RF) exposures. Effects of RF exposure on the blood–brain barrier (BBB) have been generally accepted for exposures that are thermalizing. Low level exposures that report alterations of the BBB remain controversial. Exposure to high levels of RF energy can damage the structure and function of the nervous system. Much research has focused on the neurochemistry of the brain and the reported effects of RF exposure.

In [12] was published works, focusing on the microwave portion of the nonionizing electromagnetic spectrum. The topics discussed include investigation of microwave effects on the spontaneous action potentials and membrane resistance of isolated snail neurons, effects on the permeability of blood brain barriers in rats, the phenomenon and interaction mechanism for the microwave auditory effect (the hearing of microwave pulses by animals and humans), the development of miniature catheter antennas for microwave interstitial hyperthermia treatment of cancer, the application of transcatheter microwave ablation for treatment of cardiac arrhythmias, and the use of noninvasive wireless technology for sensing of human vital signs and blood pressure pulse waves.

In [13] was studied the dielectric properties of various cancers, namely brain tumor, breast cancer, gastric carcinoma, and colon cancer, were measured in the frequency range of 500 MHz to 5 GHz. Cancers were cultivated applying the xenograft model of growing human cancerous tissues using the specific pathogen free, homo inbred mouse (a nude mouse).

In [14] was related the objective of the present studies was to investigate whether millimeter wave (MMW) therapy can increase the efficacy of cyclophosphamide (CPA), a commonly used anti-cancer drug. The effect of combined MMW-CPA treatment on melanoma growth was compared to CPA treatment alone in a murine model. MMWs were produced with a Russian made YAV-1 generator.

In [15] was related epidemiological studies of radio frequency (RF) exposures and human cancers include studies of military and civilian occupational groups, people who live near television and radio transmitters, and users of mobile phones. Many types of cancer have been assessed, with particular attention given to leukemia and brain tumors. The epidemiological results fall short of the strength and consistency of evidence that is required to come to a conclusion that RF emissions are a cause of human cancer.

Although the epidemiological evidence in total suggests no increased risk of cancer, the results cannot be unequivocally interpreted in terms of cause and effect. The results are inconsistent, and most studies are limited by lack of detail on actual exposures, short follow-up periods, and the limited ability to deal with other relevant factors. In some studies, there may be substantial biases in the data used. For these same reasons, the studies are unable to confidently exclude any possibility of an increased risk of cancer. Further research to clarify the situation is justified. Priorities include further studies of leukemia in both adults and children, and of cranial tumors in relationship to mobile phone use. Bioelectromagnetics Supplement 6:S63–S73, 2003.

In [16] was related the effect of millimeter electromagnetic waves (MWs) on cyclophosphamide (CPA) induced toxicity to leukocytes, bone marrow cells,

and T-cell-mediated immunity was examined. For studying the effect of MWs on CPA induced leukopenia and myelosuppression, BALB/C mice were irradiated for 3 days, 30 min each day, prior to administration of CPA (200 mg/kg). MWs were produced with a Russian made YAV-1 generator. The device produced 42.2_0.2 GHz modulated wave radiation through a 10mm_20mm rectangular output horn. The animals were irradiated on the nose area. Peak SAR and incident power density were measured as 622_100 W/kg and 31_5 mW/cm2, respectively. For studying the effect of MWs on CPA induced suppression of T-cell mediated immunity, a delayed type hypersensitivity (DTH) assay in mouse skin was used. The DTH reaction in mouse skin was induced by topical application of dinitrochlorobenzene (DNCB) and quantified by measuring the increase in ear thickness and by histological examination.Treatment of animals with CPAsignificantly ($P<0.05$) reduced leukocyte and bone marrow cell population, butMWirradiation did not show any significant protection from the immunosuppressive effects of CPA.

Furthermore,MWirradiation did not protect the animals from CPA induced suppression of T-cell mediated immunity. Bioelectromagnetics 23:614–621, 2002.

In [17] was related we present critiques of epidemiologic studies and experimental investigations, published mostly in peer-reviewed journals, on cancer and related effects from exposure to nonionizing electromagnetic fields in the nominal frequency range of 3 kHz to 300 GHz of interest to Subcommittee 4 (SC4) of the International Committee on Electromagnetic Safety (ICES). The major topics discussed are presented under the headings Epidemiologic and Other Findings on Human Exposure, Mammals Exposed In Vivo, Mammalian Live Tissues and Cell Preparations Exposed In Vitro, and Mutagenesis and Genotoxicity in Microorganisms and Fruit Flies. Under each major topic, we present minireviews of papers on various specific endpoints investigated. The section on Epidemiologic and Other Findings on Human Exposure is divided into two subsections, the first on possible carcinogenic effects of exposure from emitters not in physical contact with the populations studied, for example, transmitting antennas and other devices. Discussed in the second subsection are studies of postulated carcinogenic effects from use of mobile phones, with prominence given to brain tumors from use of cellular and cordless telephones in direct physical contact with an ear of each subject. In both subsections, some investigations yielded positive findings, others had negative findings, including papers directed toward experimentally verifying positive findings, and both were reported in a few instances. Further research on various important aspects may resolve such differences. Overall, however, the preponderance of published epidemiologic and experimental findings do not support the supposition that in vivo or in vitro exposures to such fields are carcinogenic. Bioelectromagnetics Supplement 6:S74–S100, 2003.

In [18] was related *e*ffects of radiofrequency electromagnetic fields (RFEMF) on the pituitary adrenocortical (ACTH), growth (GH), and thyroid (TSH) hormones have been extensively studied, and there is coherent research on reproductive hormones (FSH and LH). Those effects which have been identified are clearly caused by heating. The exposure thresholds for these effects in living mammals, including primates, have been established. There is limited evidence that indicates no interaction between RFEMF and the pineal gland or an effect on prolactin from the pituitary gland. Studies of RFEMF exposed blood cells have shown that changes or damage do not occur unless the cells are heated. White cells (leukocytes) are much more sensitive than red cells (erythrocytes) but white cell effects remain consistent with normal physiological responses to systemic temperature fluctuation. Lifetime studies of RFEMF exposed animals show no cumulative adverse effects in their endocrine, hematological, or immune systems. Cardiovascular tissue is not directly affected adversely in the absence of significant RFEMF heating or electric currents. The regulation of blood pressure is not influenced by ultra high frequency (UHF) RFEMF at levels commonly encountered in the use of mobile communication devices. Bioelectromagnetics Supplement 6:S187–S195, 2003.

In [19] was related this article is a reviewof the effects of radiofrequency (RF) energy on (1) survival and (2) cancer in the same animal populations having survival data. The literature consisted of 18 studies with survival data, and 16 of these have information on cancer. In one study, a significant decrease in lifespan was observed at 6.8 W/kg but not at 2 W/kg. Thermal stress appears to be the causal factor for the effect on lifespan because the higher dose rate, unlike the lower dose rate, was estimated to increase body temperature significantly. The finding that the lower level was without effect is consistent with the results of a number of recent studies showing that long term, low level exposure to RF energy did not affect survival adversely. Many of these recent studies addressed the cancer issue by histopathological analysis of many organs and tissues following exposure up to 2 years, the average lifetime of rats and mice. Some investigations examined the effect of RF fields from mobile phones on brain cancer, including the progression of chemically induced brain cancer. The results demonstrate that RF exposure did not adversely affect cancer incidence at whole body specific absorption rates (SARs) 4 W/kg and brain SARs 2.3 W/kg. The weight-of-evidence of these 18 studies shows that long term, low level exposure to RF energy does not adversely affect survival and cancer in laboratory mammals. Bioelectromagnetics Supplement 6:S101–S106, 2003.

In [5] was related one of the major side effects of chemotherapy in cancer treatment is that it can enhance tumor metastasis due to suppression of natural killer (NK) cell activity. The present study was undertaken to examine whether millimeter electromagnetic waves (MMWs) irradiation (42.2 GHz) can inhibit tumor metastasis enhanced by cyclophosphamide (CPA), an anticancer drug. MMWs were produced with a Russian-made YAV-1 generator. Peak SAR and incident power density were measured as 730_100 W/kg and 36.5_5 mW/cm2, respectively. Tumor metastasis was evaluated in C57BL/6 mice, an experimental murine model commonly used for metastatic melanoma. The animals were divided into 5 groups, 10 animals per group. The

first group was not given any treatment. The second group was irradiated on the nasal area with MMWs for 30 min. The third group served as a sham control for group 2. The fourth group was given CPA (150 mg/kg body weight, ip) before irradiation.

The fifth group served as a sham control for group 4. On day 2, all animals were injected, through a tail vein, with B16F10 melanoma cells, a tumor cell line syngeneic to C57BL/6 mice. Tumor colonies in lungs were counted 2 weeks following inoculation. CPA caused a marked enhancement in tumor metastases (fivefold), which was significantly reduced when CPA-treated animals were irradiated with MMWs. Millimeter waves also increased NK cell activity suppressed by CPA, suggesting that a reduction in tumor metastasis by MMWs is mediated through activation of NK cells.

Bioelectromagnetics 27:258–264, 2006.

In [7] was related to identify the mechanisms of biological effects of mm waves it is important to develop accurate methods for evaluating absorption and penetration depth of mm waves in the epidermis and dermis. The main characteristics of mm wave skin dosimetry were calculated using a homogeneous unilayer model and two multilayer models of skin. These characteristics included reflection, power density (PD), penetration depth (d), and specific absorption rate (SAR). The parameters of the models were found from fitting the models to the experimental data obtained from measurements of mm wave reflection from human skin. The forearm and palm data were used to model the skin with thin and thick stratum corneum (SC), respectively. The thin SC produced little influence on the interaction of mm waves with skin. On the contrary, the thick SC in the palm played the role of a matching layer and significantly reduced reflection. In addition, the palmar skin manifested a broad peak in reflection within the 83–277 GHz range. The viable epidermis plus dermis, containing a large amount of free water, greatly attenuated mm wave energy. Therefore, the deeper fat layer had little effect on the PD and SAR profiles. We observed the appearance of a moderate SAR peak in the therapeutic frequency range (42–62 GHz) within the skin at a depth of 0.3–0.4 mm. Millimeter waves penetrate into the human skin deep enough (dj0.65 mm at 42 GHz) to affect most skin structures located in the epidermis and dermis.

In [21] was related much of the research and reviews on extremely low frequency (ELF) electric and magnetic fields (EMFs) have focused on magnetic rather than electric fields. Some have considered such focus to be inappropriate and have argued that electric fields should be part of both epidemiologic and laboratory work. This paper fills the gap by systematically and critically reviewing electric-fields literature and by comparing overall strength of evidence for electric versus magnetic fields. The review of possible mechanisms does not provide any specific basis for focusing on electric fields. While laboratory studies of electric fields are few, they do not indicate that electric fields should be the exposure of interest. The existing epidemiology on residential electric-field exposures and appliance use does not support the conclusion of adverse health effects from electric-field exposure. Workers in close proximity to high-voltage transmission lines or substation equipment can be exposed to high electric fields. While there are sporadic reports of increase in cancer in some occupational studies, these are inconsistent and fraught with methodologic problems. Overall, there seems little basis to suppose there might be a risk for electric fields, and, in contrast to magnetic fields, and with a possible exception of occupational epidemiology, there seems little basis for continued research into electric fields.

In [22] was related as the application and commercial use of millimeter- and submillimeter-wavelength radiation become more widespread, there is a growing need to understand and quantify both the coupling mechanisms and the impact of this long wavelength energy on biological function. Independent of the health impact of high doses of radio frequency (RF) energy on full organisms, which has been extensively investigated, there exists the potential for more subtle effects, which can best be quantified in studies which examine real-time changes in cellular functions as RF energy is applied. In this paper we present the first real time examination of RF induced changes in cellular activity at absorbed power levels well below the existing safe exposure limits. Fluorescence microscopy imaging of immortalized epithelial and neuronal cells in vitro indicate increased cellular membrane permeability and nanoporation after short term exposure to modest levels (10-50 mW/cm2) of RF power at 60 GHz. Sensitive patch clamp measurements on pyramidal neurons in cortical slices of neonatal rats showed a dramatic increase in cellular membrane permeability resulting either in suppression or facilitation of neuronal activity during exposure to sub-μW/cm2 of RF power at 60 GHz. Non-invasive modulation of neuronal activity could prove useful in a variety of health applications from suppression of peripheral neuropathic pain to treatment of central neurological disorders.

In [23], stress reaction - this is a generalized reaction. In this regard, particularly in its formation play an important role interconnections, primarily realized between the nervous, humoral and visceral systems of the body. In cases where the physiological response assumes the character of stress, among the earliest signs of this transition are changes in autonomic components. In this case, the main indicators of the metabolic status of becoming a significant importance for the diagnosis of acute and chronic stress. In this regard, the objective of this study was to examine the influence of terahertz waves at frequencies of molecular spectrum of emission and absorption of nitric oxide 150,176-150,664 GHz poststressornye changes in metabolic status of male rats. Studied blood samples from 60 white mongrel male rats weighing 180-220. As a model to simulate disturbances of the metabolic status of the white male rats, used a long immobilization stress - fixation of rats on their backs for 3 hours, daily, for 5 days. Biochemical studies of the main characteristics of the metabolic status, in particular, lipid and carbohydrate meta-bolism, indicators of exchange of nitrogen compounds, transaminases and lactate dehydrogenase were carried out on an automatic biochemical analyzer Vitalab Flexor «E» (Vital Scientific, The Netherlands). Daily for 5 days of exposure xiphoid process of sternum of animals in a state of chronic immobilization stress, was carried by electromagnetic

waves at terahertz frequencies of molecular spectrum of emission and absorption of nitric oxide 150,176-150,664 GHz at a power density - 0.2 mW/cm2, prescribed apparatus "EHF - Orbita." Exposure to terahertz radiation at frequencies of nitric oxide 150,176-150,664 GHz to 5 minutes per animal in a state of prolonged stress, not cause statistically significant changes of indices of metabolic status. That daily for 5 days exposure to the stress of electromagnetic terahertz waves at frequencies of nitric oxide 150,176-150,664 GHz to 15 minutes, there is partial, but more pronounced than in the daily 5 - minute exposure mode, the normalization of metabolic status, as statistically restored only triglyceride levels, whereas all other investigated metabolic parameters was significantly different from the control group.

With daily for 5 days, the application of terahertz radiation at the frequencies of molecular spectrum of emission and absorption of nitric oxide 150,176-150,664 GHz to 30 minutes there is complete recovery of all parameters, characterizing the metabolic activity of the internal environment of an organism.

In this work [24], reported that compensation of the geomagnetic field to a level less than 0.4 μT («zero magnetic field», or ZMF) affected human cognitive processes. The compensation of the geomagnetic field was organized in a special wood box of 1×1×1.5 m3 in size. The box included a wire mesh that shielded a person from the outer randomly variable electrostatic field. A similar wire mesh inside the box generated a controllable electrostatic field that modeled the outer field in magnitude but was constant in time and direction. Magnetic field inside the box was measured near the human head to supply a feedback. This allowed the active system of magnetic exposure to compensate the outer magnetic field together with its variations caused by the city electric vehicles and industrial pulses. Forty tested persons who all have given their informed agreement to take part in the experiment were tested for the perfection of their cognitive processes. Each person has been tested twice: in ZMF and, for comparison, in sham conditions. The second session was organized usually in 30–50 days after the first one. Measured were the parameters (task processing times and the number of errors) of the following tests: (i) the rate of a simple motor reflex, (ii) colored words recognition, (iii) short-term color memory, and (iv) recognition of rotated letters. There were eight measurable parameters altogether. Under ZMF, the number of errors was grown and the task processing times were increased by about 2%, in average. This conclusion was made after the measured values were statistically treated using MANOVA. However, individual effects that deviated from the mean by more than «three sigma» have been found in the array of magnetic effects calculated from the measured parameters. At that, practically all of them had the same sign as the observable mean effect. It was unclear in what extent could these readings change the main result of the work, the statement that ZMF affects the parameters of the persons' cognitive processes in average? Therefore, in the present work, methods of multivariate statistical analysis other than MANOVA have been used to study individual human sensitivity to zero magnetic fields. Using the discriminant analysis and the factor analysis, indices of the individual sensitivity of 40 persons have been defined and calculated. Previously reported findings that women and elderly people are more sensitive to ZMF have been confirmed. Temperature and pressure did not influence significantly on the effects of ZMF. At the same time, the effects of ZMF depended on how persons felt and on their allergic status. It has been shown, that non-allergic persons who felt «excellent» executed tests better when those who had occasional allergic reactions and/or felt just «well» or «moderately well». Based on the individual sensitivity indices, different distributions of the magnetic effects over persons have been calculated. Then, the group of persons particularly sensitive to ZMF and that of persons showing no such sensitivity were separated. In the group of sensitive persons, the average magnetic effects reached 9%, and the number of errors in letter recognition reached 28%. The known syndrome of electromagnetic hypersensitivity (EHS) is discussed with regard to these findings.

In [25], irradiation of animals at the state of acute stress with theragert waves at the frequency of molecular spectrum emission and absorption of nitrogen oxide 150,176 – 150,664 GHZ of high facility during 15 minutes don't cause normalization of platelet aggregation properties and behavior reactions of animals. Irradiation of animals at the state of acute stress during 30 minutes don't cause statistically equivalent changes in indexes of platelet aggregation ability in comparison with indexes of acute immobilization stress. During analysis of animal behavior in Small's labyrinth were shown statistically equivalent increasing of total time during which animals transit the labyrinth and total time of washing. It was shown that exposure to rays of white mail rats situated in conditions of acute stress with theragertz waves at the frequency of molecular spectrum emission and absorption of nitrogen oxide 150,176 – 150,664 GHZ of high facility during 60 minutes bring to increasing of functional platelet activity – increasing of their ability for aggregation. During it occur statistically equivalent increasing of maximal size of formed platelet aggregates, maximum speed of formed platelet aggregates, time of maximum speed of aggregation in comparison with data of acute stress in animals. Investigation of animal's behavior reactions show the properties of depression, because we observe increasing of time interval during which animals pass the labyrinth and summated time of washing and amount dumb drift in which fall the animals.

In[26] was related in this review the materials showing to possibility of early diagnostics of action of electromagnetic waves of a millimetric range of low intensity and a centimetric range on a wide spectrum of phototrophic and heterotrophic microorganisms – cyanobacteria, microalgae and actinomycetes. Diagnostics probably to carry out the offered method of the chemical models which have proved in a number of directions, on change of reactivity of the exometabolites allocated in the culture liquid in the course of growth by cells which is closely connected with a physiological condition of cultures producing them. Earlier we had been offered the general classification water-soluble and flying exometabolites, connected with functions carried out by them which their regulating role in natural biocenoses is shown. Changes in qualitative and quantitative structure

of native exometabolites serve as the important information on a physiological condition producing them unicelled and multicelled and according to these changes properties of exometabolites and, as consequence, functions carried out by them can vary. The works begun by us in 1986-88, have shown presence of stimulating action of a unitary irradiation by millimetric waves of low (not thermal) intensity (EHF-radiation) on phototrophic organisms – cyanobacteria (prokaryote) and green microalgae (eukaryote). At the irradiated cultures the biomass exit, growth rate and viability of cells increased. Also the effect of an intensification of photosynthetic processes in cells of the irradiated cultures, accompanied by increase in the maintenance of photosynthetic pigments in cells, and also increase of excretion by them in medium of some organic connections has been found out. Also correlation between level of stimulation of growth of cultures by means of the physical factor and corresponding values reactivity of the native exometabolites has been received. Changes of daily and hour rhythmic of reactivity of the exometabolites at the irradiated cultures of cyanobacteria and microalgae have been received. Thus, it is possible through the integrated characteristic offered by us allocated in medium exometabolites, received by means of chemical model, quickly, during tens minutes to estimate various influences on objects already on early terms of growth, diagnosing character and level of their influence. A number of experiments have been executed on action EHF- and microwave radiation on not photosynthetic organisms – actinomycetes in which the stimulating effect also has been shown at an irradiation of spore suspension and mycelium cells which size also, as well as phototrophic objects correlated with changes of reactivity of the native exometabolites.

Use of values reactivity of the exometabolites in culture liquid at partners of the mixed cultures consisting from heterotrophic (actinomycetes) and phototrophic (cyanobacteria, green microalgae) microorganisms, as an indicator was studied at creation of the mixed cultures. The materials presented in this review show possibilities of early diagnostics of the influence EHF- and microwave radiation on cultures of phototrophic and heterotrophic microorganisms, proceeding from values reactivity of the native of exometabolites in culture liquid that is connected with a physiological condition of cultures which can change under the influence of such physical factor as electromagnetic radiation of low intensity.

In [27] was related the influence of the low intensive electromagnetic radiation extremely high-frequency band on activity of the process peroxide oxidation and antioxidant activity of blood in vitro have been studied. Biochemical investigation was conducted according to the standard clinical and instrumental criteria. Radiation of donor blood (stabilizator – heparin) took place in the diapason of frequency 48-67 GHz (density of power stream 0.2 mW/sm2, time of radiation 70 minute). The presents of the narrow interval of frequencies is established (~ 64.5 GHz) that meets the stimulation of the ferment activity – catalases with simultaneous reducing of consist thiabarbiturate sourness-active product. That testifies about great stopping of the lipid peroxidation processes. These changes took place with increasing of the erythrocyte peroxide resistension figures and general antioxidant activity of blood.

In our research papers [28-42] was studied the interaction of the immune system with tumor cells, usage of extremely high frequency electromagnetic waves in medicine in general and particularly in the treatment of mammary gland cancer and genecology, also were researched non-linear, stochastic and cooperative effects during the interaction of millimeter waves with medical-biological objects, and the conformational molecular transformations of the electromagnetic field during the interaction with biomacromolecules. After this researches were registered several patents for the treatment of breast

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