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Extended Certification of The Human Genome

Ikhlov BL
EDO Lighthouse, Perm, Russia

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Abstract

The purpose of the study is metagenomics, a generalization of the human genome certification program by including the genome of bacteria necessary for humans. A new point is the classification of the responses of DNA and RNA of human cells to an external electromagnetic field. Accordingly, a number of ranges are presented, and formulas for the natural frequencies of DNA are obtained. A formula is given for the oscillations of the ring DNA as a whole, presumably in the terahertz range. A general formula for the longitudinal oscillations of the DNA helix is obtained, and it is shown that these oscillations can be caused by radio waves of the low and medium frequency range. Data on resonances of DNA oscillations in the ultraviolet range are analyzed, and a mechanism for enhancing DNA self-repair under the influence of ultraviolet is proposed. It is determined that in the centimeter range, DNA fluctuations are associated with torsional vibrations of DNA spirals. Differential equations describing the torsional oscillations of DNA under replication conditions, taking into account dissipation, are considered, and their solution is found. Graphs of absorption of centimeter waves by E. Coli M17, Micobacterium Avium 104 Micobacterium tuberculosis H37Rv DNA molecules, where absorption peaks coincide with the calculated frequency, are presented. Formulas for the frequency of a number of modes of mechanical vibrations of the DNA molecule are given, and a formula for longitudinal vibrations of nucleosomes along the primary DNA helix is obtained.

The formula for torsional vibrations of the secondary DNA helix is obtained.It is shown that in short DNA molecules, as well as in covid-19 RNA, for which the resonances of torsional vibrations of the spirals lie in the range of 50-400 GHz, there is a subharmonic resonance at multiple frequencies in the centimeter range, the effect of which can be enhanced by using a pulse mode. The formula for the oscillation frequency of single-stranded RNAs is given. Practical conclusions from studies of DNA spectra are given. The necessity of an integrated approach and integration of databases in the topic of DNA certification of the human body is indicated.

***Corresponding Author:** Ikhlov BL, EDO Lighthouse, Perm, Russia.

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Introduction

The certification of the human genome involves the identification of a person by his genome. That is, it involves the determination of all his genetic material.

Extended certification involves the inclusion in the genome, including the genome of E. coli, of possible pathogenic viruses in the body, which must be classified according to their response to an external electromagnetic field.

Due to the development of the electrical appliance industry, automation, telemechanics, computing, radio and other technology, the issue of environmental safety of devices surrounding humans is becoming more acute. In particular, there is a problem associated with the effect of external electromagnetic fields on the DNA of human cells, as well as on the DNA of bacteria of the intestinal flora. This leads to a new task of DNA certification - in terms of classifying the responses of DNA cells of the body to an external electromagnetic field. On the other hand, since the DNA of chromosomes of different people differ, albeit slightly, in the number of base pairs, the frequencies of the electromagnetic field to which DNA responds will also differ, which may become the basis for identification.
Let's briefly list the studied ranges of electromagnetic waves and explain the research method. DNA molecules are able to respond to low- and medium-frequency waves. The centimeter spectrum of DNA was studied in [1-3]. In the elastic rod model, it was found that the action of centimeter waves on E. coli DNA with a frequency equal to the natural frequency of DNA torsional vibrations leads to a sharp decrease in the survival of the bacterium. Using Lagrangian formalism and using experimental data, a formula for this frequency is obtained:

$$f = k / \sqrt{N} \qquad (1)$$

k = 21,75 TGHz, N – number of base pairs in DNA [3].
Formula (1), expressed in terms of the number of turns n, will have the form:

$$f = q / \sqrt{10n}$$

These formulas are common to all c molecules with a double helix. There are studies on the effects of millimeter waves on DNA in vivo, but they cannot be considered correct due to the low penetration depth. The terahertz (subterahertz) range was studied in [4-11]. In [5] it is stated that each DNA base corresponds to an absorption frequency, the authors believe that hydrogen bonds are responsible for resonance in the terahertz range [9].
The infrared spectrum of DNA is caused by quantum transitions between electronic levels. The maximum absorption is 253.7 nm. It is possible that at 260 nm there is a maximum absorption by histone oligomers.

Degrees of freedom Fluctuations in bacterial (inside the human body) DNA can be associated with such a degree of freedom as the rotation of the ring DNA as a whole around attachment to the cell membrane. The cyclic frequency is equal to

$$\omega = 4\pi (k / m)^{1/2} / r$$

where m is the mass of the molecule, k is the stiffness coefficient of the DNA ring attachment to the membrane, and r is the radius of the ring. Due to the fact that the DNA molecule is neutral and microwaves act on dipoles along the length of the spiral of the molecule, the amplitude of vibrations should be extremely small. Another degree of freedom of the DNA molecule is the longitudinal vibrations of nucleosomes along the primary DNA helix. There are no synchronous oscillations at small amplitudes. In the solenoid model, there are 6 nucleosomes for each step of the fibrillar spiral, in a more realistic model, where nucleosomes are connected into oligomers, the number of nucleosomes per turn of the secondary spiral varies. The connected oscillations of three oligosomes with different numbers of monomers with one free and the other fixed end are described by the equation

$$\Upsilon^{\mu\nu} X_{\mu} = 0$$

X_{μ} - отклонения от положения равновесия. Равенство нулю детерминанта матрицы Υ дает уравнение

$$kM_1M_2(f_1f_2)^2 + kM_1M_3(f_1f_3)^2 + kM_2M_3(f_2f_3)^2 - M_1M_2M_3(f_1f_2f_3)^2 = 0$$

where fi is the cyclic frequency, Mi is the mass of the oligomer, and k is the stiffness coefficient. A particular solution is the standard expression

$$f = \sqrt{k / M}$$

where M is the harmonic mean Mi. The formula is generalized for an arbitrary number of oligosomes.

The Kilohertz and Megahertz Range

Presumably, the oscillation frequencies of one DNA chain relative to another lie in this area. For longitudinal vibrations of a DNA double helix of length l, the stiffness is determined by the formula

$k = k_0 l_0 / l$

where k_0, l_0 are known stiffness and length. The length can be expressed in terms of the number of base pairs N. Then the formula for the cyclic oscillation frequency has the form

$$\omega = \frac{2}{N}\left(\frac{k_0 N_0}{2m}\right)$$

where m is the mass of the DNA base pair. Using the data [13], we obtain k_0 = N/m, hence the wavelengths of longitudinal vibrations of human chromosome DNA are on the order of thousands of kilometers, bacterial DNA is on the order of kilohertz, and rings of fibrils with 105 nucleotide pairs in each are on the order of megahertz.

Centimeter Range

The effect of centimeter waves on DNA was studied, in particular, it was found that microwave deactivates bacterial cells, it was assumed that bacterial inactivation is a consequence of deactivation of genes regulating oxidation and DNA damage [14]. In particular, Staphylococcus aureus bacteria were irradiated with a pulsed field with a peak frequency of 3.5 GHz. However, in this work, as in all works devoted to the centimeter range, the mechanism of the effect of microwaves on DNA has not been identified, there is no justification that the effect of microwaves was not thermal. In the absence of replication, the natural frequency of torsional vibrations of DNA is expressed by the formula (1).

Torsional vibrations of the secondary DNA helix are described by formula (1), but due to changes in the radius of the coil and its mass, the coefficient before the formula becomes 0.28 x 21.75 = 6.09 THz. In the presence of replication, the moment of inertia of DNA turns increases due to the formation of replication forks, approximately the moment of inertia of a set of DNA turns I can be represented as I = I0 + at. To account for friction, you need to use Lagrange equations of the 2nd kind. At high frequencies, a quadratic term is added in the expansion of the friction force by velocity:

$$(I_0 + at)\ddot{\varphi}_1 + a\dot{\varphi}_1 + b\dot{\varphi}_1 + c\dot{\varphi}_1^2 - k(\varphi_2 - \varphi_1) = 0$$

$$(I_0 + at)\ddot{\varphi}_2 + a\dot{\varphi}_2 + b\dot{\varphi}_2 + c\dot{\varphi}_2^2 + k(\varphi_2 - \varphi_1) = 0$$

where k is the coefficient of rigidity, c, a and b are constants, are the angles of twisting of the ends of the DNA helix, I_0 is the initial moment of inertia of the halves of the helix. Let's make the equations dimensionless, introduce

$$g = a / I_0\omega_0; \omega_0 = \sqrt{2k / I_0}; \eta = \omega_0 t$$

Then the equations will look like:

$$(1 + g\eta)\ddot{\varphi} + g\dot{\varphi} + \varphi = 0$$

An increase in the moment of inertia replaces friction; at g much less than one, the frequency decreases linearly. Taking into account friction, the quadratic velocity term of the system of equations reduces to the Riccati equation:

$$\ddot{\Phi} = (u\tau - v)\Phi.$$

Φ and r – redefined angle and time, u, v - constants. The solution has the form:

$$\Phi = c_1 Ai\left(\frac{u\tau - v}{u^{2/3}}\right) + c_2 Bi\left(\frac{u\tau - v}{u^{2/3}}\right)$$

where Ai and Bi are Airy functions, thus the resulting oscillations are sinusoidal with decreasing frequency and increasing amplitude over time. a direct experiment was carried out, it was shown that DNA is resonantly absorbed by centimeter waves at a frequency equal to the natural frequency of torsional vibrations of the DNA helix [15]. If we plot the curves of the absorption coefficient dependence on frequency, the peaks are sufficiently highlighted:

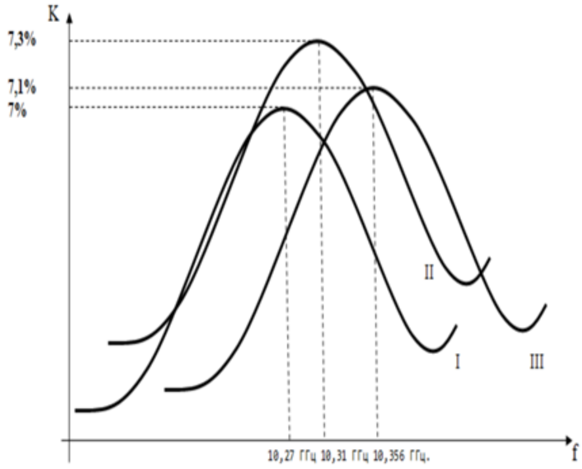

Figure1.Dependence of the DNA absorption

coefficient on the radiation frequency.

At a resonant frequency f_0 = 10.272 GHz, an effective absorption of 7.0% was obtained on an E. coli M17 culture (Fig. 1, curve I). A certain resonant frequency is close to the estimated value of 10.26 GHz. In the M. Avium 104 culture, the effective absorption was 7.3%, the resonant frequency was f_0 = 10.317 GHz and close to the calculated 10.31 GHz (Fig. 1, curve II). In Mycobacterium tuberculosis H37Rv culture – 7.1%, f0 = 10.356 GHz and close to the calculated value of 10.36 GHz (Fig. 1, curve III).

The number of nucleotide pairs of human DNA is tens and hundreds of times greater than that of bacterial DNA. The natural frequency range of torsional vibrations of 23 different human DNA ranges from 1.97 to 4.29 GHz. For clarity, the data for calculating the natural frequencies of torsional vibrations of human DNA are summarized in

We recalculate the dependence of E. coli survival on the time of exposure to EMF on the dependence of survival on frequency [12].

Table 1:

The dependence of the natural frequencies of torsional vibrations of the human DNA helix on the average number of nucleotide pairs in a particular DNA

Тип	*N*	*f*, GHz
Y-chromosome	59 373 566	4,00
X-chromosome	155 270 560	2,46
1st	249 250 621	1,91
6th хромосома	171 115 246	2,37
2nd	243199373	1,97
3-rd	198022430	2,19
4	191154276	2,22
5	180915260	2,29
7	159138663	2,44
8	146364022	2,54
9	141213431	2,59
10	135534747	2,64
11	135006516	2,65
12	133851895	2,66
13	115169878	2,87
14	107349540	2,97
15	102531392	3,04
16	90354753	3,34
17	81195210	3,41
18	78077248	3,48
19	59128983	4,00
20	63025520	3,87
21	48129895	4,43
22	51304566	4,29

The natural frequencies of torsional oscillations of E. coli DNA of the intestine are in the range of 9.5 – 10.5 GHz. The human intestine contains an average of about 50 trillion. There are about 1.3 times more bacteria than the total number of cells in the body. For clarity, Table 2 shows a small number of gastrointestinal bacteria of different classes with their characteristics

Table 2
Characteristics of the bacteria of the gastrointestinal tract

Name	DNA Mb	f_{res} GHz
Bacteroides fragilis	5,2	9,54
Anaerofustis stercorihominis	2,2	14,66
Enterococcus faecalis	2,9	12,77
Enterobacter sp. SA187	4, 429 597	10,33
Klebsiella sp. D5A	5 ,540 009	9,24
Bifidobacterium bifidum	2,2	14,66
Staphylococcus aureus	2,8	13,0
Lactobacillus	2,0	15,38
Clostridium perfringens	3,3	11,97
Proteus mirabilis	4,0	10,875
Clostridium tetani	2,8	13,0
Clostridium septicum	3,2	12,16
Pseudomonas aeruginosa	6,6	8,466
Christensenella minuta	2,95	12,66

The data in both tables are illustrative, given for convenience, obtained by searching, selecting, averaging and using the ratio (1). It should also be understood that the response to these frequencies depends on the irradiation time, the power flux density (non–thermal level) of radiation, etc., i.e., the data in the table is only the first step. For some bacteria, only approximate values of DNA length and, accordingly, approximate frequencies of torsional vibrations of the DNA helix are given.

Millimeter Range

Human plasmid DNA contains 3 x 105 base pairs, the frequency of torsional vibrations from the ratio (1) is about 40 GHz, the wavelength is 7.55 mm.

The Range is 50-400 GHz

In this intermediate range lie the frequencies of torsional vibrations of short DNA spirals, in particular, human mitochondrial DNA (16,569 base pairs), as well as DNA of blood lymphocytes. The nitrogenous base in RNA, complementary to adenine, is not thymine with a molar mass of 126.11334 g/mol, as in DNA, but uracil with a molar mass of 112.08676 g/mol (an unmethylated form of thymine). That is, the mass and, accordingly, the moment of inertia of the spiral coil is less.

The effect of an external electromagnetic field on disordered RNA twists non-spiral sections of the chain into a spiral, therefore formula (1) is also valid for single RNAs. As a result, we have:

$$f_{RNA\_SINGLE} = 31{,}196 N^{-1/2}$$

where N is the number of bases (not pairs). For double helix RNA or for two RNAs in a capsid

$$f_{RNA\_DUBLE} = 22{,}0589 N^{-1/2}$$

It was shown that the effect of these frequencies on the DNA of human blood lymphocytes in vitro leads to a sharp increase in the number of single-strand breaks [16]. In vivo exposure is difficult due to the skin effect that prevents the penetration of a high-frequency electromagnetic field. However, it is possible to use tens of times smaller multiples of frequencies that cause subharmonic resonance. Resonance occurs at all frequencies of the driving force, which satisfy the ratio $mf - nf_0 = 0$, where m, n are small integers. In our case, it is necessary that the frequency ratio be a half-integer: $f_0 = 3nf/2$, where $n = 1, 2, 3...$ Indirectly, the excitation of subharmonic resonance by multiples of frequencies in the centimeter range in amoebocyte DNA molecules was confirmed in, direct confirmation in [17-18].

Frequencies of the Order of 1012 Hz

In addition to the inter-level transitions of molecules O2, CO, H2O, etc., in addition to the resonances of rotational and vibrational transitions of various neutral in general, it is not possible to excite classical mechanical bending vibrations in it with an electromagnetic field with a frequency of terahertz.

The IR Spectrum

The infrared spectrum of DNA, as indicated was studied, the data were generalized, absorption lines are associated with fluctuations in individual bonds between atoms (see classification in [20]) [12, 19].

Ultraviolet Spectrum

The effect of daylight causes the effect of hormesis in a number of bacteria, for example, in E. coli [21, 22]. UV excites the DNA electronic system. Absorption maxima lie below 315 nm, but absorption also occurs at 532 nm with coherent radiation, when the energies of two photons are added up. It is also possible that there is a resonant effect of ultraviolet radiation of the frequency lying on the border of UV-A and UV-B on the DNA level system. UV transforms the molecule into an excited state, which in the semiconductor model facilitates the transition to the conduction band, which enhances DNA self-repair. It is possible that the mechanism of DNA self-repair is associated with transitions through the forbidden zone [22].

Conclusion

The insufficiency of generally accepted DNA models, in addition, the uncertainty in the interpretation of DNA spectra means the need for an integrated approach and database integration. On the other hand, already at the level of fibrillation loops, their fixation on the nuclear matrix necessarily leads to a change in natural frequencies, which can be determined using tensor analysis, as, for example, in [23, 24], but with reference to experimental data and practical application.

Since non-thermal centimeter waves freely pass through the human body, they can be used both in the suppression of malignant neoplasms and in the treatment of infectious diseases, tuberculosis, etc. [25].

The effect of increasing the survival rate of intestinal flora bacteria under the action of UV can be used in medicine.

The multiple frequency method can be applied in terms of RNA rupture of viruses such as covid-19, the parameters of which correspond to the parameters of the DNA of lymphocytes. Extended certification of the human genome may provide an opportunity for medical recommendations of various kinds. Individual identification can be carried out using the exact frequencies.

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