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Investigation of Structural Human Recombinant Growth Hormone Changes Under Electromagnetic Waves with a Frequency of 940 MHz

Mehdi Mohammadpour-Aghdam, Ahmad Molaei Rad*, Reza Farajidana, Azadeh Azizi

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Abstract

Today, the study of the biological effects of non-ionizing electromagnetic waves (EMFs) (RF) is one of the most important subjects of theoretical and experimental studies. The purpose of this study was to evaluate the biological effects of human recombinant growth hormone (rhGH) Exposed to electromagnetic waves with a frequency of 940 MHz.Results of protein construction studies using dichroism (CD) circular experiments showed a destructive effect on the second building of the protein.In addition, the protein under the waves increases the fluorescence emission relative to the hormone Human recombinant growth is normal, which is possible Related to the development of protein building and the formation of abnormal collisions in protein and structural transformation.The results of dynamic light scattering (DLS) and Zeta potential test indicate that RF-EMFs have led to an increase in superficial load and rhGH size. Our results show that 940 MHz electromagnetic waves can alter the recombinant human growth hormone protein structure.

Key words: Electromagnetic waves, human recombinant growth hormone (rhGH), second building, biological effects.

Introduction

All electronic equipment, including telecommunication and non-telecommunication equipment, generates electromagnetic waves due to the electric current, whose wavelength range overlaps with the range of interactions between human cells, as well as electromagnetic waves easily by tissues Always absorb water and thus have a high negative impact through the disruption of biological and molecular proceses (Mateescu and et al, 2007).

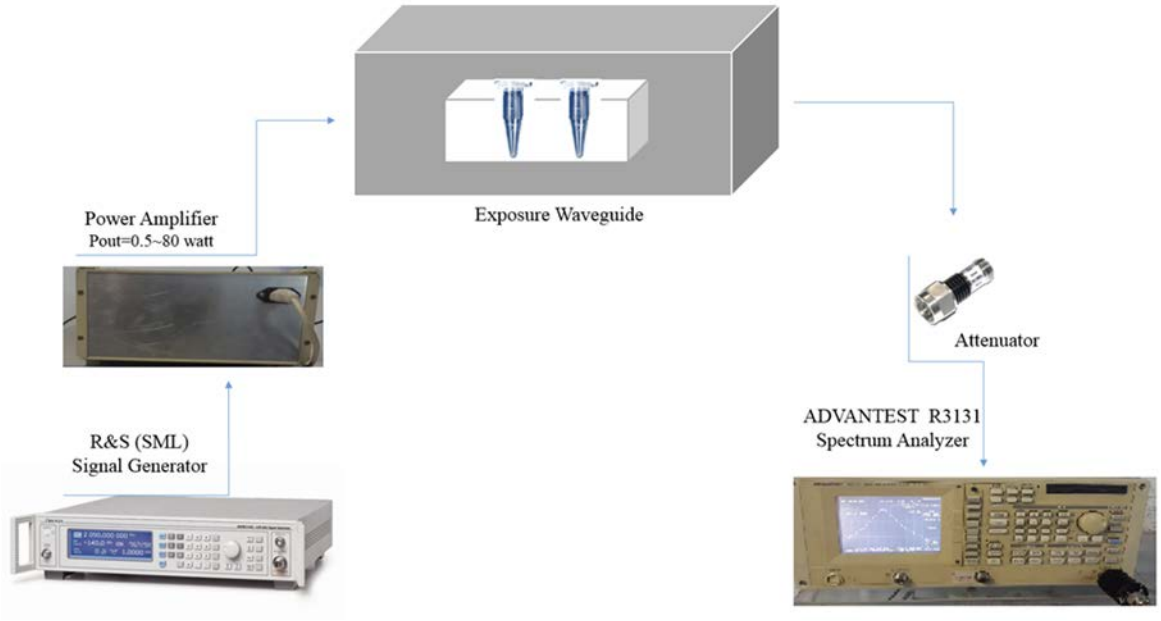
On the other hand, with the advancement of technology and the rise of radio facilities, the electromagnetic energy emitted from these devices has been increasing around us, but the effects of these waves on human biological processes, especially molecular processes such as protein folding, have been less studied. The effect of electromagnetic waves on the building of nucleic acids has been proven (Hekmat and et al, 2013) Therefore, these waves in the building of proteins, and especially on the second building, will also be effective. Therefore, understanding the mechanism of the effect of electromagnetic waves on the chemical or physical processes of protein tissues can be achieved. To this end, the aim of this article is to investigate the effect of electromagnetic waves at 940 MHz on the second building of recombinant human growth hormone. The single-chain polypeptide human growth hormone protein consists of 191 amino acids, secreted from the previous part of the pituitary gland. The molecular weight of this protein is about 22 kDa (Johnson, 1983). The second structure of the protein consists of alpha helix, which is connected to two basic loops by two disulfide bands (Sindelar and et al, 2013). Growth hormone protein is a non-glycosylated protein and therefore expressed as recombinant in both prokaryotic and eukaryotic systems (Blijlevens & Sonis, 2006). The high consumption of this protein as a drug has increased the demand for recombinant production (Roifman and et al, 1985). All wireless telecommunication systems emit electromagnetic energy, and the basis of all wireless radio communications is the emission of electromagnetic waves in space. These waves are easily absorbed by living tissue containing water. The effect of these waves on the recombinant human growth hormone protein and possible changes in the structure of this protein can affect the function of this yard protein.

Mehdi Mohammadpour-Aghdam, Ahmad Molaei Rad *, Reza Farajidana, Azadeh Azizi
Biotechnology Research Center, Malek Ashtar University of Technology, Tehran
Bioelectromagnetic Laboratory, Faculty of Engineering and Engineering, University of Tehran, Iran

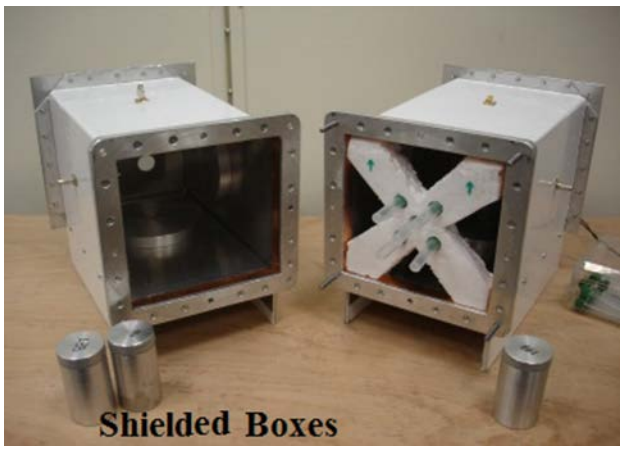
***Email:** molaeirad@gmail.com

Materials and Methods

In this paper, it is attempted to study electromagnetic waves with a frequency of 940 MHz in telecommunication systems on the human recombinant human growth hormone protein building. For this purpose, it is necessary to focus on the protein in the appropriate frequency band of the systems with proper power of electromagnetic waves. For this purpose, radio equipment, as well as waveform systems, have been used in the Bioelectromagnetic Lab of the Faculty of Electrical and Computer Engineering, University of Tehran (Fig. 1).



A. Block of diagram of the electromagnetic energy concentration



C: The location of biological samples within the waveguide B: GSM bandwidth 900 MHz

Fig. 1: Appropriate arrangement for the concentration of electromagnetic energy on a sample in the Bioelectromagnetic Lab of the University of Tehran (Hekmat and et al, 2013).

In this research, we have tried to investigate the effect of electromagnetic waves emitted from a mobile phone with a wavelength of 940 MHz on the growth hormone structure using available biochemical-biochemical techniques. In this first step, for the sample waveform, the protein purchased from the company The onion powder, powdered, dissolved in a trisse buffer with a physiological pH and was coated (Krichevsky & Bonnet, 2002).

The waveform was performed at 37 ° C for 45 minutes, all of which were compared to the control. Investigating changes in protein structure using rotary exponential duplex, fluorescent, DLS, Zeta potentials.

Study of structural changes using intrinsic fluorescence technique

Inborn publication is one of the easiest and most powerful methods to investigate changes in the third structure in proteins. Changes in the position of aromatic roots (mainly tryptophan) in the protein form the basis of this study. Due to the presence of tryptophan roots in the human growth hormone structure, the intrinsic release of the natural form and the form under the human growth hormone wave was studied (Krichevsky & Bonnet, 2002).

The protein samples diluted to a concentration of 0.4 mM with a Tris-HCl buffer (pH = 7.4) and, after being bubbled, immediately dispersed the fluorescence intensity in the wavelength range (420-480 nm) using a spectrofluorimetric apparatus (Cary Eclipse) was measured.

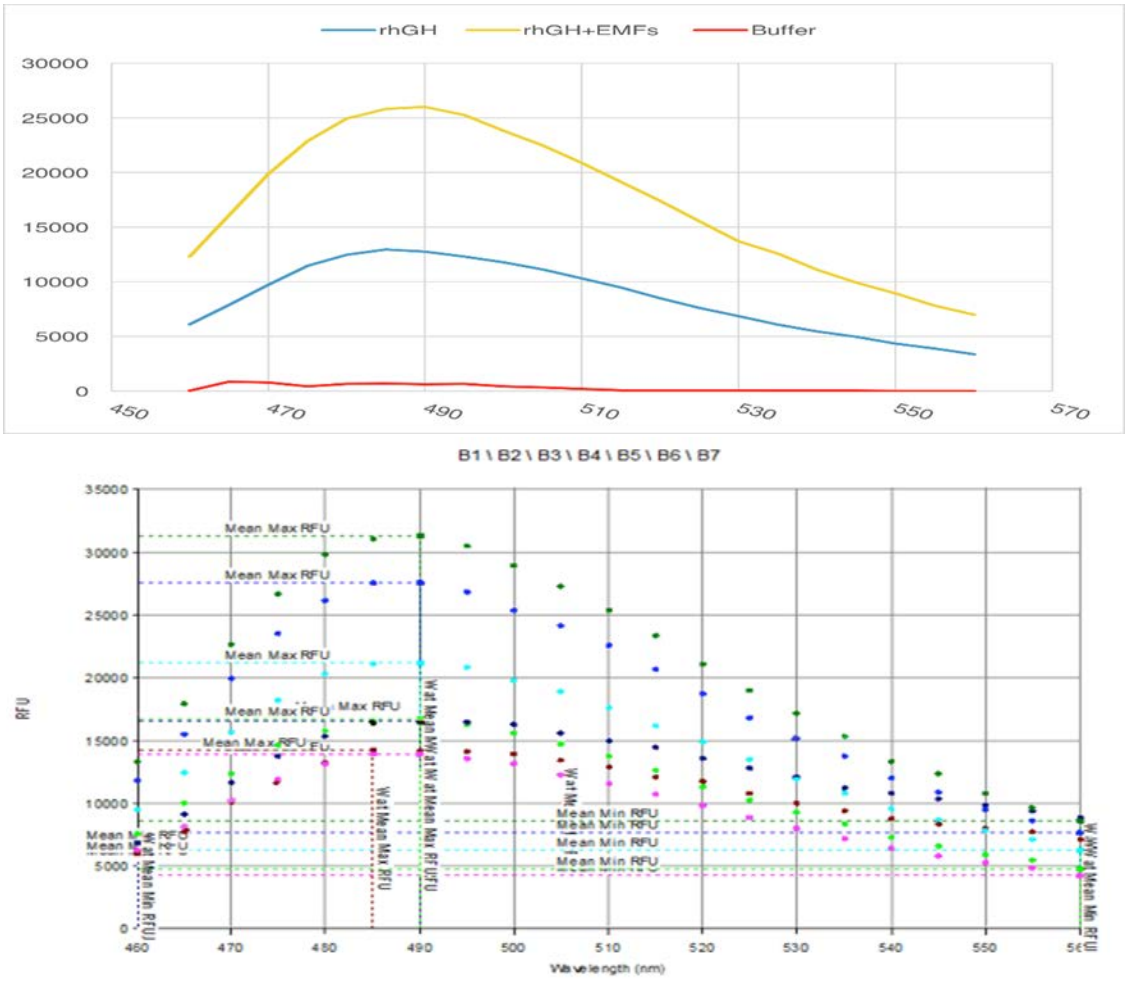


Fig. 2: Investigating the effect of electromagnetic waves on growth hormone protein using fluorescence assay. Increase in the fluorescence of the growth hormone protein after exposure (▬) after 45 minutes of maturation at 37 ° C. Lack of control protein fluorescence intensity under similar conditions in the absence of (▬) waves. All samples at a concentration of 0.4 mM protein. Size Were made.

Study of structural changes using circular dichroism (CD)

Circular Dichroism Spectroscopy (CD) is an effective method for evaluating the second structure of proteins. The basis of Circular Dichroism Spectroscopy (CD is the difference between the absorption of right and left turning polarized light in a light-active molecule. The difference in the absorption of the polarizing light rotating component causes the light emitting light emitted from the material to rotate, which is due to the combination of the right and left beam of the incoming light After passing through the material, the tangent is said to be an elliptical rotating angle that can be measured at different wavelengths of the viscosity spectrum, with the difference in

absorption. Often, vital macro-molecules such as proteins, nucleic acids and carbohydrates, due to variation in form and asymmetry, have spectra with special features (Hekmat and et al,2013), the pattern of the second structure of the protein is characterized by the use of circular dichroism spectroscopy (CD) spectrophotometry spectroscopy (Schippers & Dekkers, 1981). Therefore, by comparing the pattern of the second structure of the protein, the protein after 45 minutes of radiation and the control protein, by two colored exponential spots (Aviv model 215; Lakewood, NJ, USA) were performed at a spectral range of 195-260 nm with 1 mm quartz tubes and 0.4 mM protein concentrations and examined structural changes in the protein.

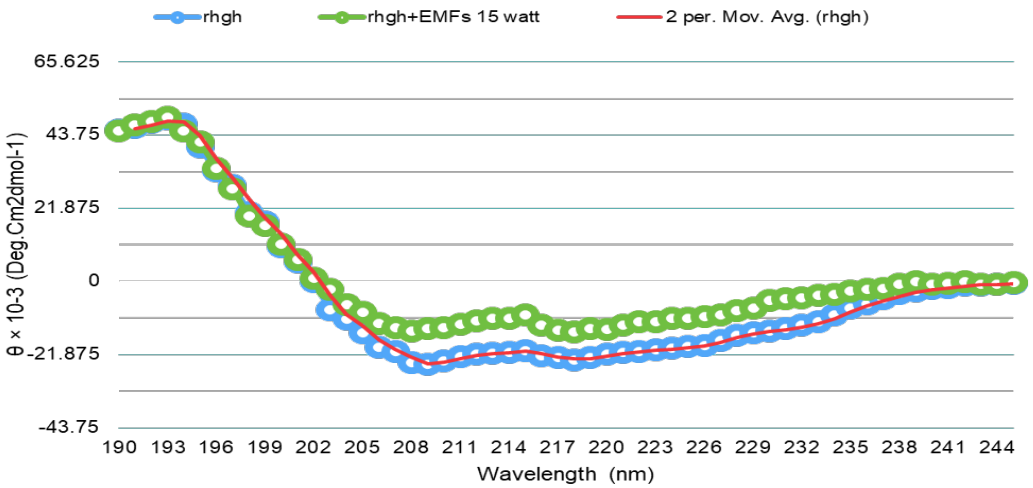


Fig. 3: The CD range is the protein bound region under the waves. (-) Protein control (in the absence of waves); (-) Protein samples analyzed by circular dichroism spectroscopy (CD) after 45 minutes of wave exposure at 37 ° C. All samples were measured at a concentration of 0.4 mM protein.

Dynamic light scattering

Most liquids contain ions with positive and negative charges (cations and anions). When charged particles are suspended in a liquid, opposite charge ions are attracted to suspended particles, which means that the sample with negative charge, the positive ions are absorbed from the liquid to their side and, in contrast to the positive charge sample, absorbs negative ions from the liquid to itself. Near the surface of the particle, strongly charged adsorbant ions create a solid electrostatic bond. (Stern layer), while at distances away from the surface of the particle, the ions with opposite weights establish a weaker bond and even ion Intrinsically, there are boundaries in which the ions within this boundary move with the motion of the particle in the liquid, and the ions beyond the boundary remain stationary. This slippage boundary The potential between the surface of the particle and the fluid is changed by the distance from the surface of the particle. The potential difference between the surface of the particle and the slip boundary is called the zeta potential (ζ). Zeta's potential provides accurate information on the dispersal and stability mechanism of biomolecules (Krichevsky & Bonnet, 2002).

DLS was used to investigate the zeta potential of the normal form and the form under protein waves. The concentration of samples prepared for measuring it is about 0.15 ml / mg.

Table 1: Zeta potential of the normal form and form under protein waves

	Size[d_h,nm]	PdI
hGH	6.2±0.2	0.164±0.031
hGH+EMFs	7.3±0.1	0.209±0.001
	pH	Zeta Potential
hGH	7.0	-8,35±1.5
hGH+EMFs	7.0	3.3±1.6
Values represent mean ± standard deviation, n=3		

Dynamic Light Scattering (DLS) Results Analysis

The particles inside the fluid have superficial loads and always show an increase in the concentration of opposite ion concentrations around the particle surface that is in the fluid. Therefore, an additional layer of these ions surrounds the particle surface and another layer is created around the particle. This layer formed around the particle can be divided into two parts: the inner layer and the outer layer

(Brown & Zhao, 1993). In the inner layer to which the stern layer is also said, the ions are strictly limited and are closely interconnected. The outer layer of the ions is somewhat freer from the previous layer and its ability to move more than the previous layer (Adamson & Gast, 1967). When the particle moves inside the fluid, the outer and outer layers of the particle move along with the particle and move with the particle. So you can imagine a hypothetical distance between the particle and the fluid medium, which is the hypothetical space of the same layer that surrounds the particle. This distance is termed the hydrodynamic distance, and the potential at this distance is known as the Zeta potential (Bonaccurso and et al, 2002).

The following equation is known as the equation of arts, which is used to calculate the zeta potential. In this equation z: Zeta potential, UE: electrophoretic mobility, ε: dielectric constant, η: viscosity and f (ka): artistic function that can be 1 or 1.5 on the sample's sense.

$$U_E = \frac{2\varepsilon z f(\mathrm{ka})}{3\eta}$$ Equation 1: Arithmetic equation

As the equation above is clear, Zeta's potential is associated with electrophoretic mobility (Gittings & Saville, 1998). The results showed that the natural form of growth hormone has a higher zeta potential. The natural form of growth hormone by releasing superficial loads and reducing the hydrodynamic size of the protein increases the electrophoretic mobility of the underlying waved protein, which ultimately leads to an increase in the protein's zeta potential under the waves.

Analysis of the results of Circular Dichroism Spectroscopy (CD)

Proteins that are under waves need their own structures to function properly. Severe changes in protein structures result in a significant reduction in their performance. A UV spectral dipole spectroscopy was used to study the second structure of the natural forms and the protein form of growth under waves. The results indicate changes in the second structure of the protein. The natural form of growth hormone has a similar spectrum in the region of 222 and 208 nm, but there is no significant change in the growth protein form under the waves at 222 and 208 nm spectra.

Analysis of the results of intrinsic emission fluorescence

Fluorescence is a useful technique for investigating the third structure of proteins. Tryptophan and tyrosine amino acids in proteins can absorb ultraviolet (UV) from the electromagnetic spectrum and, after reaching the electron-evoked states, cause fluorescence to be released. The growth protein form under the waves has a lower spectrum of the natural form of human growth hormone ratio, which reflects the alteration of the aromatic roots of the nonpolar environment to the polar environment. Regarding the intrinsic emission fluorescence spectrum, it is expected that significant changes will occur in the second structure of the protein growth form under the waves. The results of doped spatial spectroscopy confirm these results.

Conclusion

Telecommunication transmitters, radar systems and radio and television transmitters, microwave ovens, cell phones and wireless, various satellite receivers and radio tv are devices that are used today and are exposed to high frequency electromagnetic rays (waves Radio and microwaves). For example, microwave ovens typically work at 1,000-600 watts at frequencies of 2450-915 MHz, which are very harmful to leakage outside. Mobile phones also send and receive waves at frequencies of 900 MHz to over 1,000 MHz (1 GHz). These waves are absorbed by the body and if the energy absorption energy exceeds 4 watts per square meter, it can cause permanent heat effects in the human body and possibly non-thermal effects. Although the effects of carcinogenesis and non-radiation effects of radio waves and microwaves are probable, these effects have not yet been cleared but have not yet been addressed and should always be considered as potential risk factors. The adverse effects of electromagnetic fields, in particular the mobile field, increasingly have a destructive role in the body, organisms, tissues, cells and vital macromolecules such as DNA, proteins, and enzymes. Currently, 940 MHz mobile phones are damaging to most body tissues, including the brain, and even meat and muscle, and should not look at the cell phone as a safe device, and anyone whoever wants to use it, Mobile applications should be limited and controlled, as well as drug use, in a dose-specific language so that a person can only use the cell only hours of the day, and then it will be harmful again. The use of mobile phones varies among people with various illnesses. Another important issue to be addressed by researchers is the specific use of mobile phones for people with various illnesses.

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