Non-linear hexagonal/pentagonal ultrasound waves of a DNA with very short wavelength propagating in an empty vacuum

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Abstract:

Backgound: The structure of a DNA within a neucleus is very similar to an inductor within a speaker/microphone and produce some ultrasound waves. In this research, we propose a model to determine shape and wavelength of DNA ultrasound waves.

Method:

A: Theoretical Method

1. We divide structure of a DNA into several linear and curved inductors. Linear inductors emit linear magnetic fields and curved inductors produce curved waves.
2. DNA inductors are built from hexagonal and pentagonal bases and consequently emit hexagonal and pentagonal waves.
3. Charged particles out and within nucleus, produce some electric fields along nuclear membranes. These fields produce some currents along membranes. These currents emit some magnetic fields which interact with DNA inductors. Thus, nuclear membranes play the role of magnets within a speaker/microphone.
4. The interaction between magnetic fields of membrane and DNA inductors lead to their motions. By motions of charged particles within DNA inductors some currents are emerged .These currents emit some extra magnetic fields.
5. Extra magnetic fields are linear or curved hexagonal and pentagonal waves depending on the shape of their radiating DNA inductor.
6. These magnetic fields interact with nuclear membranes and vibrate them. In these conditions, membranes play the role of plastic within a speaker/microphone.
7. By vibrating nuclear membranes, some linear/curved hexagonal/pentagonal ultrasound waves are emerged.

B: Experimental Method:

8. To test the model, we build several hexagonal and pentagonal magnets. These magnets produce several regions in a metal which their electrons become paralel to magnetic fields.
9. Electrons within boundary of two regions are in opposite directions respect to each other and become pair.
10. We pour some milk within two vessels and keep them between 38-40^0 C in an incubator. In these conditions, some bacteria grows.
11. These bacteria produce some ultrasound waves which break spin pairs.
12. By breaking these pairs, some currents are produced which could be observed by an scope.

Results:

1. A DNA could emit linear and curved ultrasound waves.
2. Topology of these waves is similar to topology of hexagonal/pentagonal bases within the structure of a DNA.
3. The wavelength of linear DNA ultrasound waves is around 10^{-16}m and wavelength of curved DNA ultrasound waves is around 10^{-27}m.

Conclusion:

A DNA is built from linear and curved natural inductors which act like the inductors within a speaker/microphone. These inductors are formed from hexagonal and pentagonal bases. Consequently, vibrations of these inductors produce linear/curved hexagonal/pentagonal ultrasound waves. Frequency of these waves are more than frequency of light waves and their wavelengths are smaller than size of air molecules. Thus, these waves pass air molecules and propagate in any vacuum without needing to matters.

I. Introduction

Up to date, many researchers have tried to propose a model for extracting information within cells [1,2]. In most of these models, waves of DNAs play the main role. These waves could be transverse electromagnetic fields or longitudinal ultrasound waves. A DNA is built from charged particles and according to laws of physics, by any motion of these particles, some electromagnetic waves are emerged [3]. Also, the structure of a DNA is

similar to the structure of an inductor [4] in a speaker/microphone and can produce ultrasound waves. The effects of ultrasound and sound waves on biological systems have been considered extensively. For example, some authors have investigated the effectiveness of the Ultrasound Tongue Scraper (UTS) to disrupt the structural morphology of the bacteria and their biofilm. [5]. Some other authors have shown that sound/ultrasound waves could control the rate of microbial growth [6]. In another research, authors have shown that the efficiency of the combination of ultrasonic waves under pressure with heat (MTS) for bacterial spore inactivation is directly correlated with the thermal resistance [7]. In another paper, authors have developed the new methodology of strategic ultrasound treatment on lactic acid bacteria (LAB) to induce stress response for the enhancement of β-glucosidase activity that can be used for the biotransformation of glucosides into aglycones isoflavones in soymilk [8]. In another investigation, ultrasound application on bacterial inactivation in municipal wastewater (MWW) has been evaluated [9]. In another work, it has been shown that by combinations of ultrasound, hydrogen peroxide, and active lactoperoxidase system, microbiota and selected spoilage and pathogenic bacteria in milk become inactive [10]. In other article, diagnostic accuracy of ultrasound scanning for prenatal microcephaly in the context of Zika Virus Infection has been considered [11]. In another research, authors have compared the clinical characteristics and imaging features on contrast-enhanced ultrasound (CEUS) of hepatitis B virus (HBV)-related combined hepatocellular–cholangiocarcinoma (CHC) and hepatocellular carcinoma (HCC) [12]. Motivated by these researches and using the similarity between DNAs within cells and inductors within speaker/microphones, we propose a model for determining shape and frequency of DNA ultrasound waves.

The outline of this papers is as follows: In section II, we show that a DNA could emit some ultrasound waves with short wavelength and hexagonal-pentagonal shapes. In section III, we propose a method to test the model for bacterial DNAs within the milk container. In section IV, we consider results and propose our datas. In section V, we discuss about the origin of results. The last section is devoted to conclusion.

II. Theoretical Method: Estimating topology and wavelength of DNA ultrasound waves

A speaker/Microphone is buit from an inductor, a magnet and a platic. The magnet induces a constant magnetic field within inductor. Any external field produces an extra current within wires of this inductor. According to laws of

physics, inductor produces some currents which remove effects of external fields. Interactions between this inductor and external fields lead to the vibration of system. This vibration is transformed to the platic. By motion of plastic, molecules of air move and vibrate. Vibrations of molecules of air produce sound. Now, we can show that DNAs within cells play the role of inductors within speakers/microphones and produce some sound waves. Previously, it has been shown that DNAs act like inductors and emit or receive electromagnetic waves [1]. This is because that a DNA is formed from charged particles like electrons and atoms and according to laws of physics, by their motions, some electromagnetic fields are emerged. The structure of a DNA is very similar to an inductor within speaker/microphone (See figure 1).

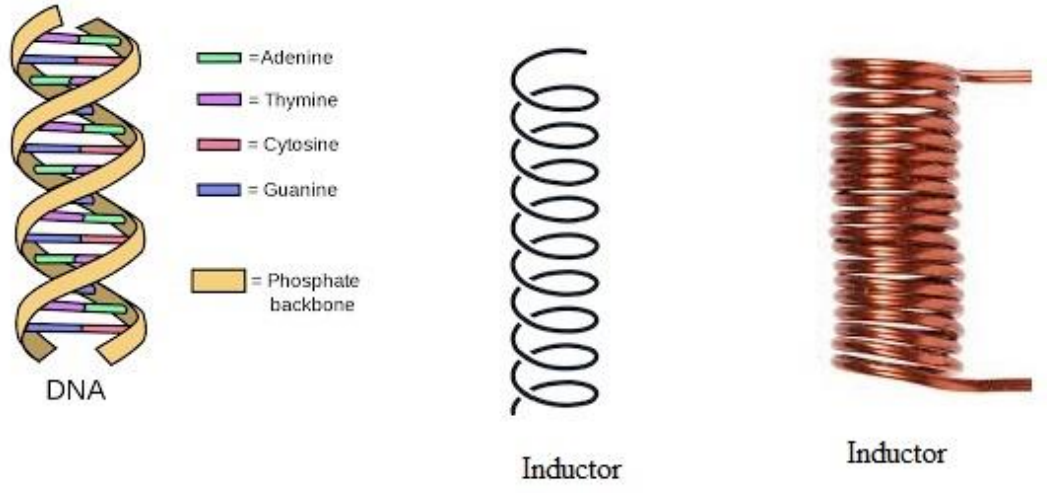

Fig1 : Similarity between inductors and DNAs

On the other hand, charged particles out and interior of nucleus, produce some electrical fields along nuclear membrane. This current produce a magnetic field and consequently, nuclear membrane plays the role of magnet within a speaker/microphone. In addition, there are some other biological matters like protein and RNAs which their structures are similar to some inductors. These objects are formed from charged particles and by their motions, some currents are emerged. These currents can produce some magnetic fields. Magnetic fields of nuclear membrane, RNAs and other biological matters interact with DNAs within cells, leads to their motions and production of new currents. These currents produce new magnetic fields. These magnetic fields move nuclear

membranes, RNAs and proteins and produce some vibrations. These vibrations produce ultrasound DNA waves. Thus, nuclear membranes, RNAs and proteins could be biological sound producer so. They could play the role of plastic in a speaker/microphone (See figure 2).

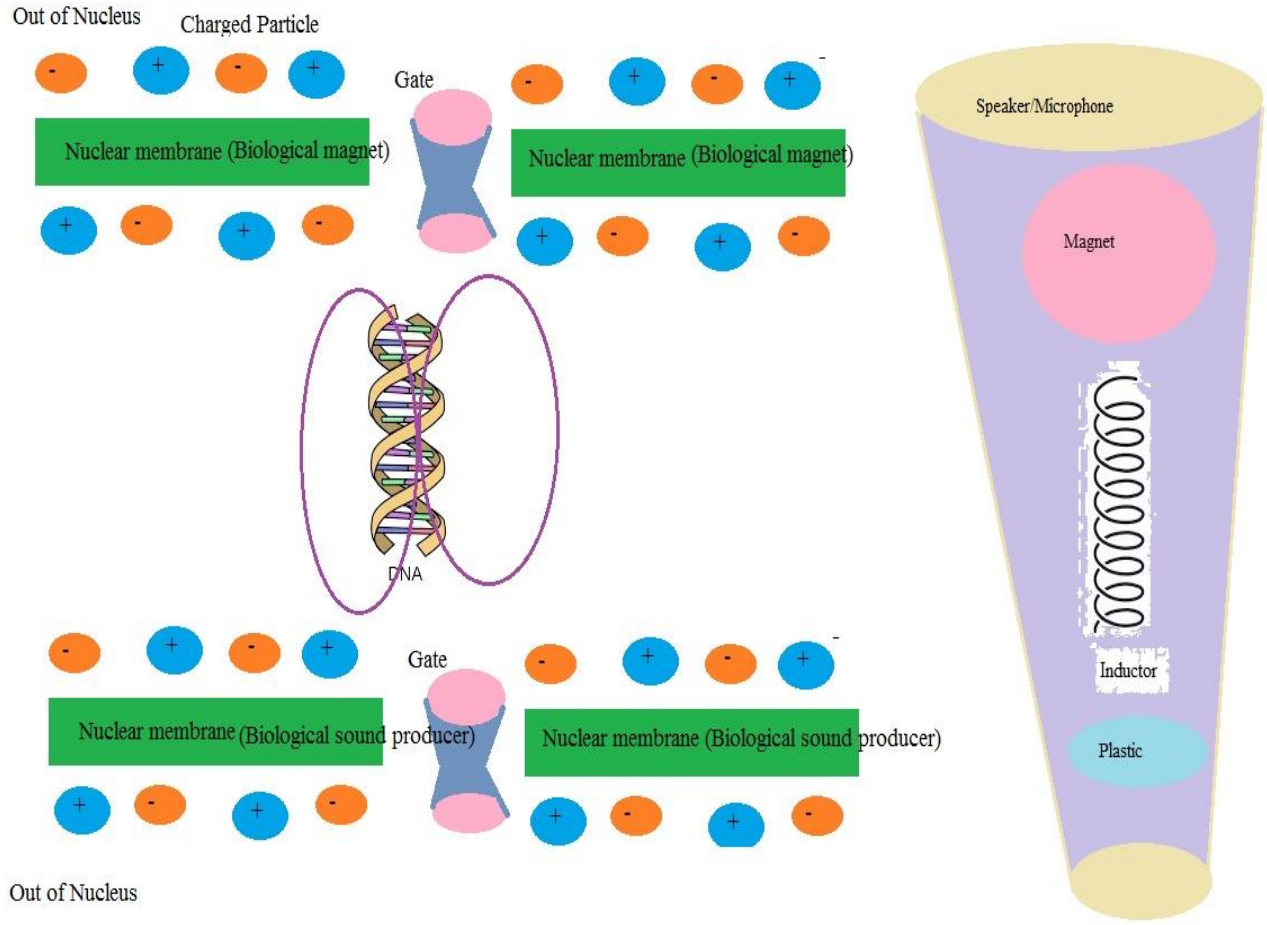

Fig 2. Nucleus acts like the speaker/Microphone

Now, the question arises that what is the relation between topology of DNA and topology of its emitted sound waves. A DNA is constructed from hexagonal and pentagonal bases. When a DNA interacts with external magnetic fields, its hexagonal and pentagonal molecules vibrate and produce hexagonal and pentagonal sound waves. Thus, these waves join to each other and form total DNA sound wave (See figure 3).

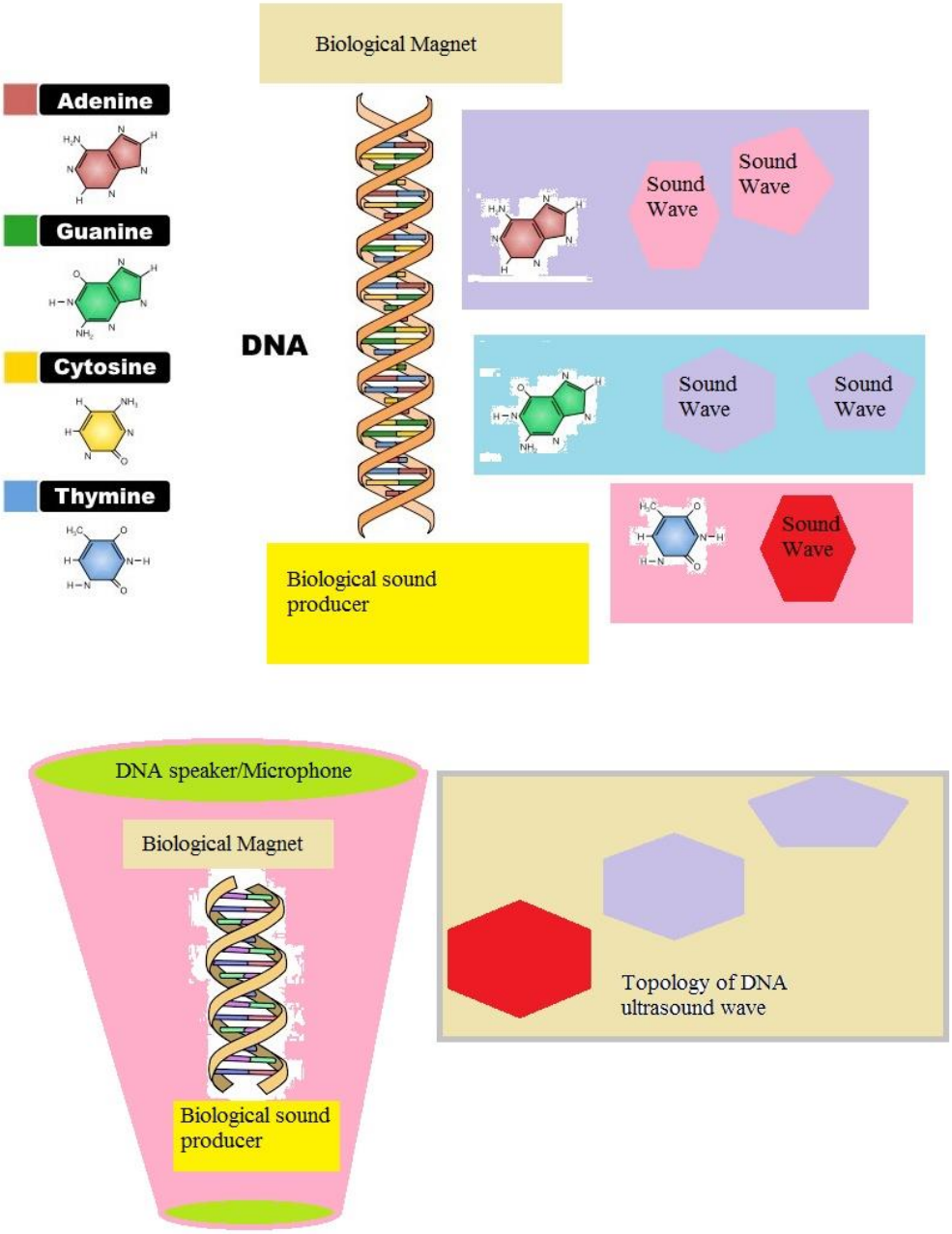

Fig 3: Topology of DNA ultrasound waves

In addition to the structure of hexagonal and pentagonal manifolds, there are some extra parameters which have direct effects on topology of a DNA. For example, a DNA is coiled around a core histone and produce an structure like the structure of a toroid inductor. Vibration of this inductor is different from a linear inductor and produce new type of sound waves (See figure 4.)

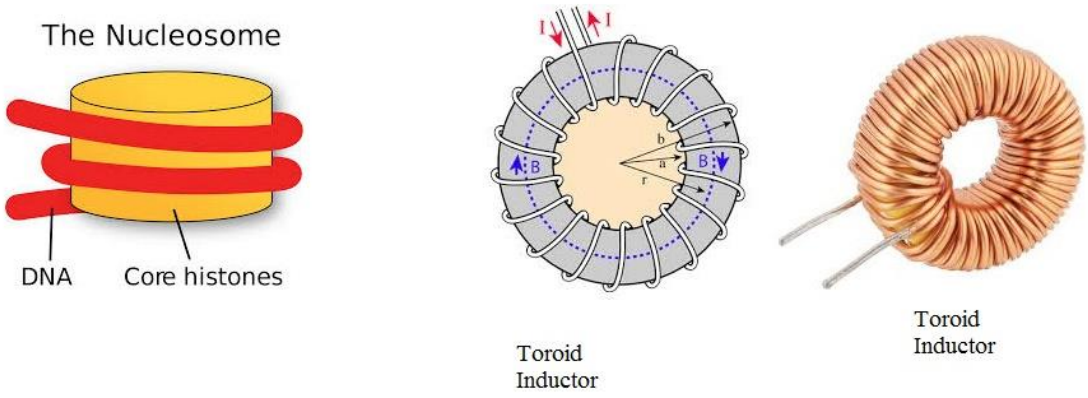

Fig 4 : A DNA could be coiled like toroid inductors

In addition to this coiling, a DNA could be coiled several times around different axes and by each coiling, its vibration changes and new type of electromagnetic waves are emerged. In fact, we can divide a DNA inductor to several new inductors. Some of them are linear and produce linear magnetic fields. Some are curved inductors and produce curved magnetic fields. Some others are toroid inductors and produce circle-like waves. These magnetic fields join to each other and form very complicated magnetic fields (See figure 5). If we regard hexagonal and pentagonal shapes of bases, we could have waves with topology of their DNA sources. In fact, waves take topology of DNAs and thus could be taken only by detectors with similar topology.

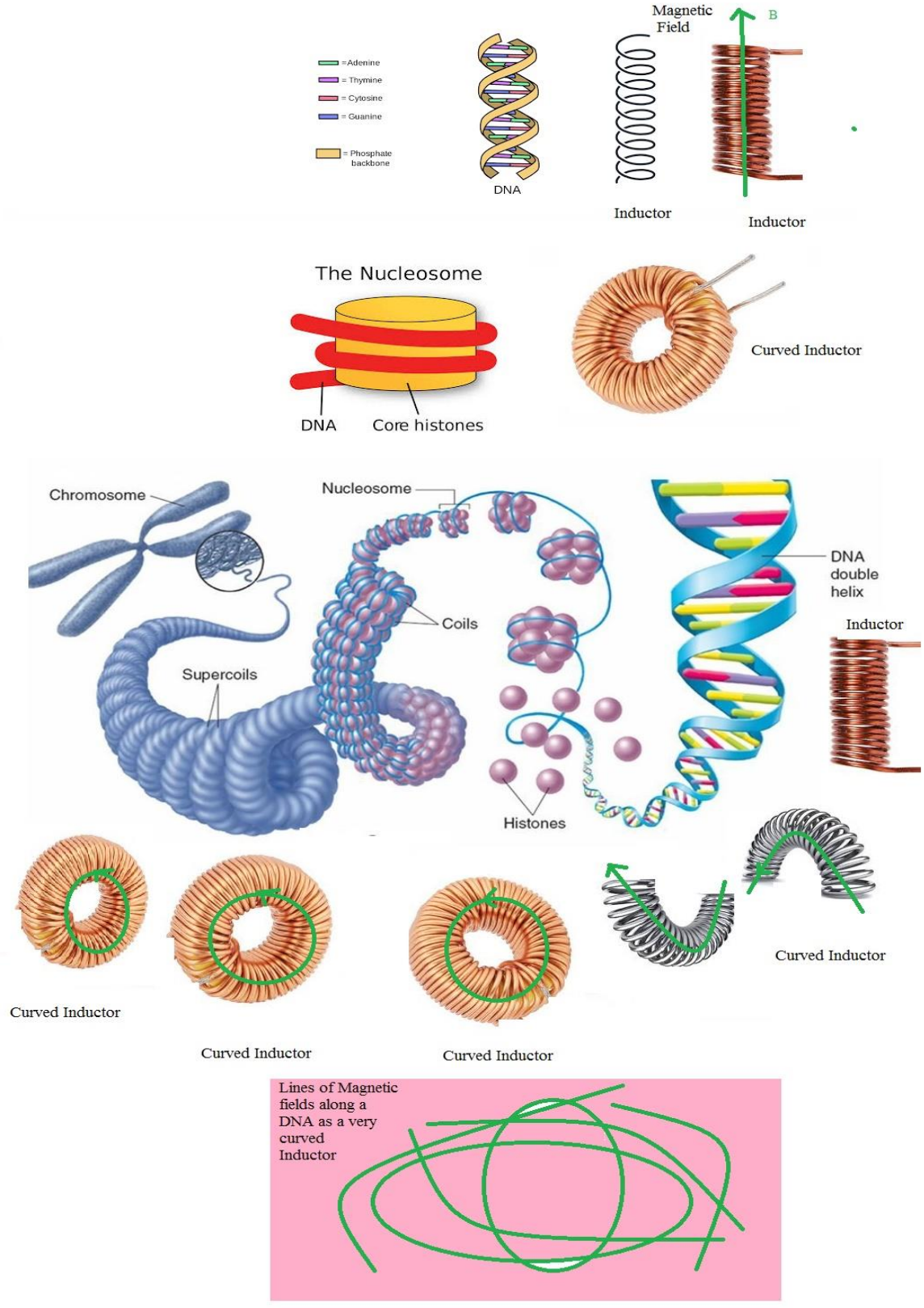

Fig 5: A DNA could be coiled several times and produce various types of magnetic fields and ultrasound waves.

To consider evolutions of a DNA, we should simulate it with several types of inductors. Some of them are linear inductors and vibrate linearly. They interact with linear biological magnets. These linear magnets could be some RNAs or some parts of nuclear membranes. These magnets interact with linear inductors of a DNA, move them and produce some extra currents. These currents produce some extra magnetic fields and these fields move nuclear membranes, RNAs and proteins and vibrate them. In these conditions, nuclear membranes, proteins and RNAs play the role of plastic in a speaker/microphone, vibrate and produce sound waves. In addition to linear inductors, there are some curved and toroid inductors within the structure of a DNA. These inductors interact with curved and toroid parts of nuclear membranes. By vibrations of these matters, some curved and toroid sound waves are emerged (See figure 6).

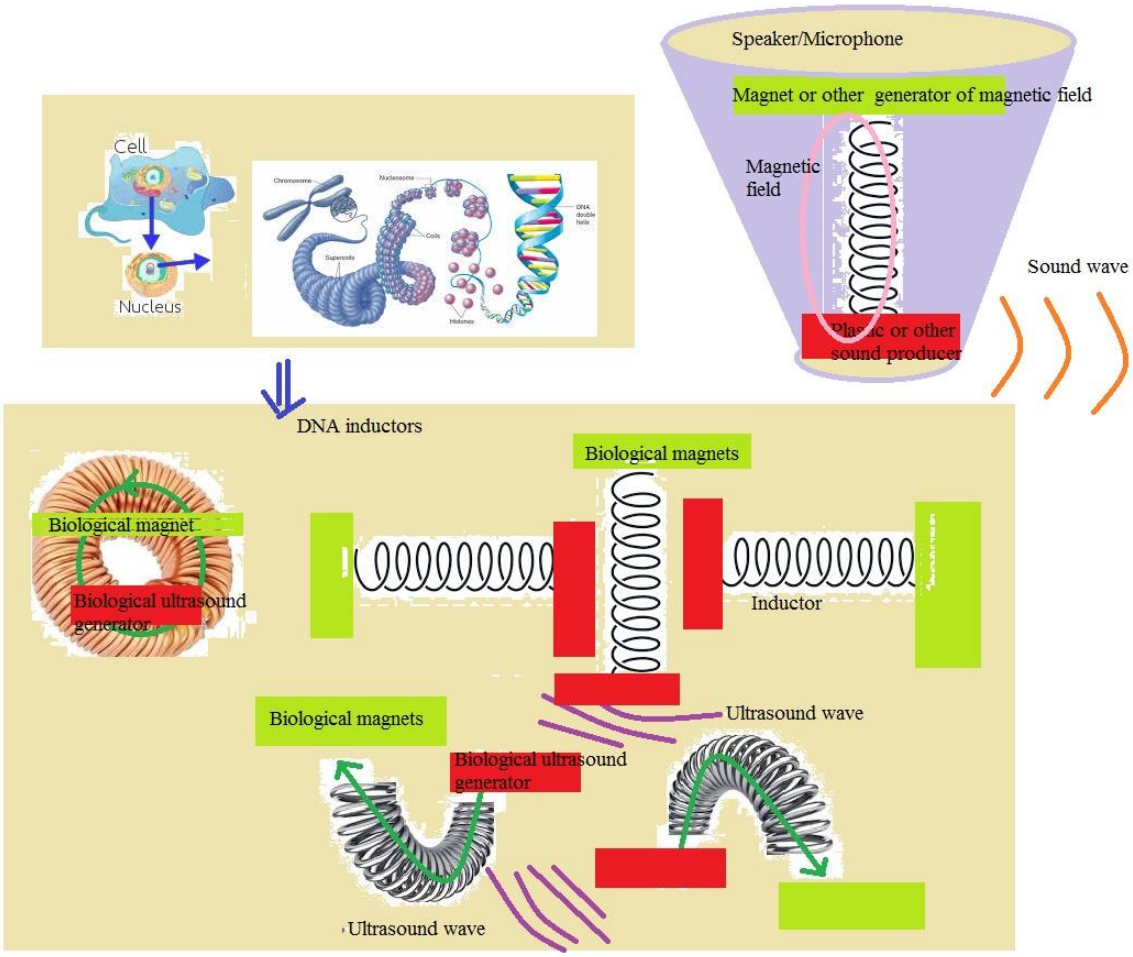

Fig 6: The behavior of a DNA could be explained by several types of inductors.

At this stage, we calculate the frequency and wavelength of a DNA sound wave. To this aim, we replace a DNA with two types of inductors. One type of these inductors are linear and vibrate linearly. In these conditions, we can write:

$$\mathbf{F = M\,a = K\,x} \qquad (1)$$

Where F is the force, K is the inductor's constant and M is its mass. For this oscillation, frequency could be obtained from below equation:

$$\mathbf{\nu = (1/\,2\pi)\omega = (1/\,2\pi)\,[K/M]^{1/2}} \qquad (2)$$

where ν is the frequency and ω is the angular velocity.

Another type of these inductors are curved and we can write:

$$\mathbf{\tau = I_\theta\,\alpha = K_\theta\,\theta} \qquad (3)$$

where $\boldsymbol{\tau}$ is torque, I_θ ($I_\theta = M_{DNA}\,r^2$) is the rotational inertia, K_θ is a constant and α is the rotating acceleration. For this inductor, the frequency can be obtained from below equation:

$$\mathbf{\nu = (1/\,2\pi)\omega = (1/\,2\pi)\,[K_\theta / I_\theta]^{1/2}} \qquad (4)$$

To calculate above frequencies, we should obtain constants and masses. We assume that a DNA acts like an inductor and thus, we write below equation for its magnetic field:

For linear inductor: $\mathbf{B_{DNA,\,linear} = \mu_0\,n_{gene}\,I_{gene}}$ (5)

For curved inductor: $\mathbf{B_{DNA,\,curved} = \mu_0\,n_{gene}\,I_{gene}/2\pi r_{histone}}$ (6)

Where n_{gene} is the density of genes [13] within DNAs**,** $r_{histone}$ is the size of histone (3×10^{-10}) [14] and I_{gene} is current which moves along genes. We assume that each gene is in fact a long wire that is coiled around the axis of a DNA. A DNA may have 50000 or more gene (N_{gene}) [13] and each gene has around 10^{-12} meter long (L_{gene}) within a cell. Thus, we can calculate density of genes (n_{gene}):

$$\mathbf{n_{gene} = N_{gene}/L_{gene}} \qquad \mathbf{(7)}$$

$$\mathbf{N_{gene} = 50000[13]} \qquad \mathbf{(8)}$$

$$L_{gene} = 10^{-12} m [15,16] \quad (9)$$

$$n_{gene} = 5 \times 10^{16} \quad (10)$$

To calculate current along genes, we should calculate total effective charge of all genes (Q_{gene}) and their velocity (V_{gene}).

$$I_{gene} = Q_{gene} V_{gene} \quad (11)$$

Effective charges of all genes are different from their normal total charges. A gene may have a few normal charges, because its charges cancel the effect of each other in the static state. However, during the gene expression and DNA evolutions, each charge has a separate effect. For this reason, we should regard total charges of all genes. To obtain this charge, we should write:

$$Q_{gene} = N_{gene} q_{gene} \quad (12)$$

Where N_{gene} is the number of genes and q_{gene} is the effective charge of a gene. Again, we insist that effective charge of a gene is different from its normal charge. In fact, we should regard all electrons and atoms that contribute in gene expression. For this reason, we should write:

$$q_{gene} = N_{base} q_{base} \quad (13)$$

where N_{base} is the number of base pairs within a gene [13,14] and q_{base} is the effective electrical charge of a base. We can put approximate numbers and obtain the effective charge of all genes:

$$N_{base} = 10^{9} [17,18] \quad (14)$$

$$q_{base} = (10\text{-}20)\, q_{electron} = (10\text{-}20) \times 1/6 \times 10^{-19} \quad (15)$$

$$Q_{gene} = 5 \times 10^{-5} \quad (16)$$

Now, we calculate the effective velocity of genes:

$$V_{gene} = L_{gene} \omega_{gene} \quad (17)$$

This velocity depends on the length of a gene (L_{gene}) and its rotating velocity (ω_{gene}).

$$L_{gene} = 10^{-12} m [15,16] \quad (18)$$

The rotating velocity of a gene (ω_{gene}) can be obtained by summing over rotating velocities of all its effective charges (ω_{charge}):

$$\omega_{gene} = n_{charge} \omega_{charge} \quad (19)$$

To obtain number of charges, we multiply number of bases and number of atoms/electrons

$$n_{charge} = N_{base}\, N_{atom} \quad (20)$$

Now, we put approximate values for numbers and obtain velocity of genes:

$$N_{base} = 10^{9}\ [17,18] \quad (21)$$

$$N_{atom} = 10 \quad (22)$$

$$n_{charge} = 10^{10} \quad (23)$$

$$\omega_{charge} = 2\pi / T_{charge} \quad (24)$$

$$T_{charge} = .1 \quad (25)$$

$$\omega_{charge} = 6.28 \times 10 \quad (26)$$

$$V_{gene} = 6.28 \times 10^{-1} \quad (27)$$

Substituting values of velocity from equation (27) and charges from equation (16) in equation (11), we can obtain the current of genes:

$$I_{gene} = 3.14 \times 10^{-4} \quad (28)$$

Putting the current from above equation (28) and density of genes from equation (10) in equations (5 ,6), we calculate magnetic field of a DNA within a cell.

$$B_{DNA,\ linear} = 985.96 \times 10^{5} \sim 10^{8} \quad (29)$$

$$B_{DNA,\ curved} = 985.96 \times 10^{15} \sim 10^{18} \quad (30)$$

Using these fields, we can obtain energy density of magnetic fields around a DNA within a cell.

$$\mu_0 = 4\pi \times 10^{-7} \quad (31)$$

$$U_{B,\ linear} = \left([B_{DNA,\ linear}]^{2} / 2\, \mu_0 \right) = 1.59 \times 10^{22} \quad (32)$$

$$U_{B,\ curved} = \left([B_{DNA,\ curved}]^{2} / 2\, \mu_0 \right) = 1.59 \times 10^{42} \quad (33)$$

At this stage, we assume that a DNA is similar to an inductor and calculate total energy of magnetic field around a DNA.

$$E_{B,\,linear} = U_{B,linear}\, V_{DNA} \quad (34)$$

$$E_{B,\,curved} = U_{B,\,curved}\, V_{DNA} \quad (35)$$

With below cylindrical area:

$$V_{DNA} = 2\pi\,[R_{DNA} + x_{DNA}][L_{DNA} + x_{DNA}] \quad (36)$$

We obtain:

$$E_{B,\,linear} = (\,[B_{DNA,\,linear}]^{2}/2\,\mu_0)\; 2\pi\,[R_{DNA} + x_{DNA}][L_{DNA,linear} + x_{DNA}] \quad (37)$$

$$E_{B,\,curved} = (\,[B_{DNA,\,curved}]^{2}/2\,\mu_0)\; 2\pi\,[R_{DNA} + x_{DNA}][L_{DNA,curved} + x_{DNA}] \quad (38)$$

Where V_{DNA} is the cylindrical space which occupied by a DNA, R_{DNA} is the radius of DNA inductor, L_{DNA} is the length of DNA inductor and x_{DNA} is a distance that DNA oscillate, go ahead and go back. Using this energy, we can obtain forces (F_{DNA}) which are created by vibration of a DNA inductor:

$$F_{DNA,\,linear} = d\,E_B/dx_{DNA} = [\,([B_{DNA,\,linear}]^{2}/2\,\mu_0)\,2\pi]\,x_{DNA} + [\,([B_{DNA,\,linear}]^{2}/2\,\mu_0)\,2\pi][\,R_{DNA} + L_{DNA,\,linear}] \quad (39)$$

We can rewrite equation (39) as follows

$$F_{DNA,\,curved} = K_{DNA,\,linear}\, x_{DNA} + constant \quad (40)$$

Where

$$K_{DNA,\,linear} = [\,([B_{DNA,\,linear}]^{2}/2\,\mu_0)]\,2\pi \quad (41)$$

To obtain torque, we should multiply above force to radius of histones:

$$\tau_{DNA} = r_{histone}\, F_{DNA,\,curved} = K_\theta\,\theta \quad (42)$$

where

$$F_{DNA,\ curved} = d E_B/dx_{DNA} = [([B_{DNA,\ curved}]^2/2 \mu_0) 2\pi] x_{DNA} + [([B_{DNA,\ linear}]^2/2 \mu_0) 2\pi][R_{DNA} + L_{DNA,\ curved}] \quad (43)$$

And thus, we can write:

$$\tau_{DNA} = r_{histone} F_{DNA,\ curved} = r_{histone} [([B_{DNA,\ curved}]^2/2 \mu_0) 2\pi] x_{DNA} + [([B_{DNA,\ linear}]^2/2 \mu_0) 2\pi][R_{DNA} + L_{DNA,\ curved}] \quad (44)$$

Putting $x_{DNA} = r_{histone}\ \theta$, we can obtain:

$$K_\theta = [r_{histone}]^2 [([B_{DNA,\ curved}]^2/2 \mu_0) 2\pi] \quad (45)$$

Using equations (29, 30, 41 and 45), we can obtain linear and curved constants:

$$K_{DNA,\ linear} = [([B_{DNA,\ linear}]^2/2 \mu_0)] 2\pi = 9.98\times 10^{22} \sim 10^{23} \quad (46)$$

$$K_\theta = [r_{histone}]^2 [([B_{DNA,\ curved}]^2/2 \mu_0) 2\pi] \sim 10^{24} \quad (47)$$

Putting above constants DNA mass ($M_{DNA} = 3.59\times 10^{-15}$ [19]) and rotating mass ($I_\theta = M_{DNA} [r_{histone}]^2$)in equations (3 and 4), we can obtain frequencies of DNAs:

$$\nu_{DNA\ ultrasound,\ linear} = (1/ 2\pi) [K_{DNA,\ linear}/M_{DNA}]^{1/2} \sim 10^{16} \quad (48)$$

$$\nu_{DNA\ ultrasound,\ curved} = (1/ 2\pi) [K_\theta / I_\theta]^{1/2} \sim 10^{27} \quad (49)$$

Frequency of waves have reverse relation with their frequencies.

$$\lambda_{DNA\ ultrasound,\ linear} = 1/ \nu_{DNA\ ultrasound,\ linear} \sim 10^{-16} \quad (50)$$

$$\lambda_{DNA\ ultrasound,\ curved} = 1/ \nu_{DNA\ ultrasound,\ curved} \sim 10^{-27} \quad (51)$$

Comparing above wavelengths with the size of air molecules (10^{-10}) [20], we conclude that ultrasound waves are very smaller than them. These short wavelengths show that ultrasound waves could pass the air molecules without any interaction with them. Thus these waves should propagate in any vacuum without needing to matter (See figure 7).

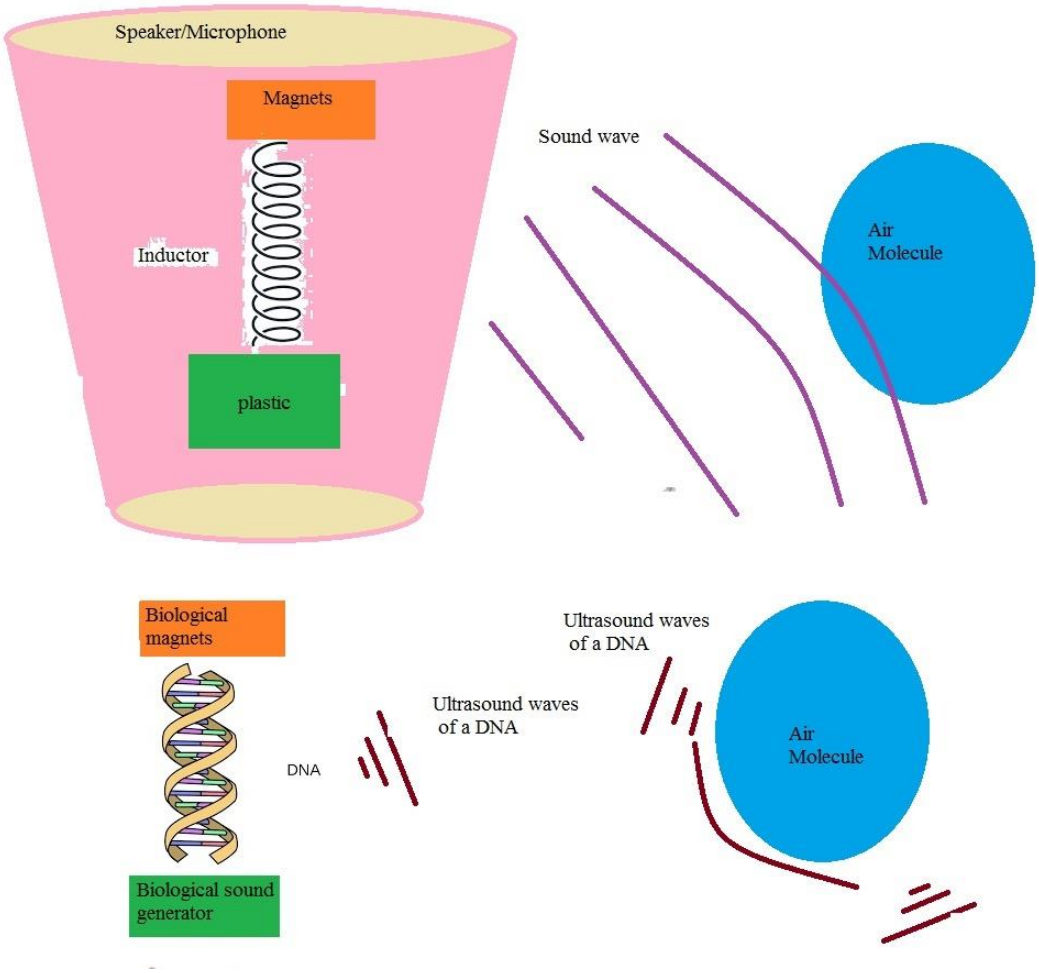

Fig 7: DNA ultrasound waves pass the air molecules

III. Experimental Method

III-A: Material:

Material

The needed materials for testing this idea are:

1. Milk
2. Two vessels
3. Thermometer

4. Scopes
5. Amperemeter
6. Metal
7. Copper wire
8. Hexagonal and pentagonal Magnets

III-B: Methods:

1. First, we should build some hexagonal and pentagonal magnets. These magnets could be produced by working on natural magnets.
2. Instead of magnets, we can produce some hexagonal and pentagonal inductors which produce hexagonal and pentagonal magnets.
3. We put hexagonal and pentagonal magnets on a surface near a metal and produce some hexagonal and pentagonal fields.
4. Direction of a magnetic field in a pentagonal or hexagonal region should be reverse to direction of a magnetic field in a region near it .
5. Electrons in each region become parallel to its magnetic field.
6. Electrons in the boundary of two magnetic fields are in opposite direction to each other and become pairs.
7. We connect the metal to an amperemeter and scope.
8. We pour milk into two vessels and keep them in a temperature around 38^0 C for some hours.
9. We put one of vessels on metal and measure currents by scope.
10. We bring other vessel near first one and measure currents again (See Figure 8).

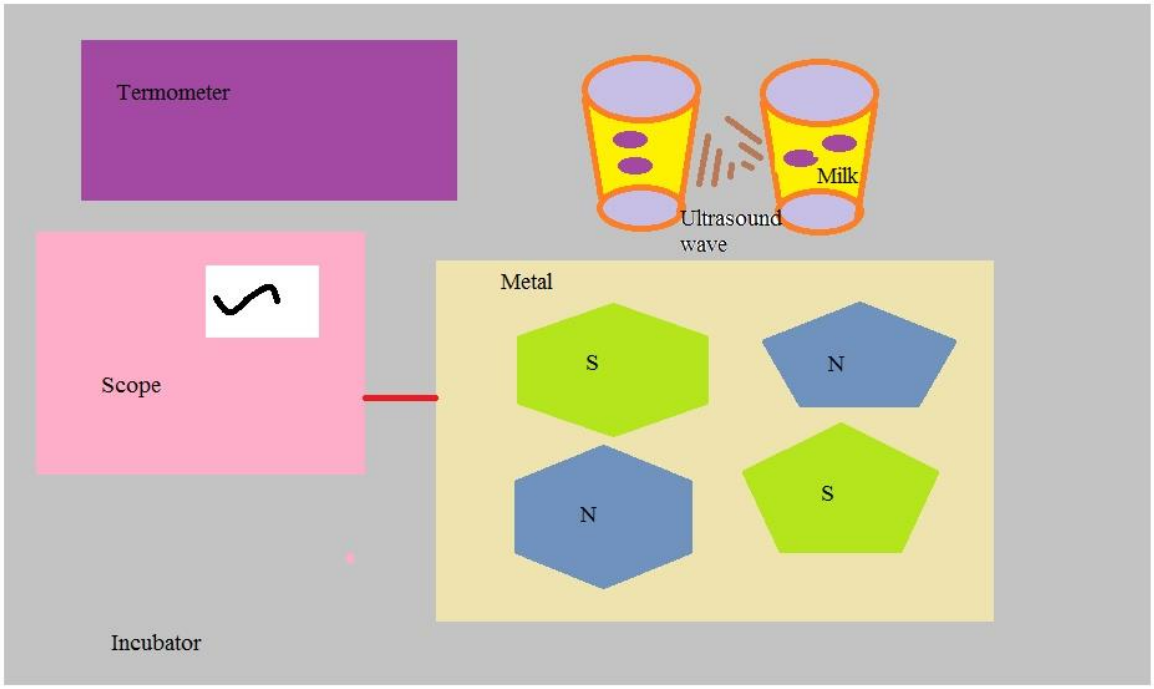

Fig 8:A circuit for taking DNA ultrasound waves

IV. Results

When a vessel of milk is kept in temperatures between 38-40^0 C for some hours, some bacteria begin to grow. If we bring this vessel near the circuit in figure 8, bacterial DNA ultrasound waves break the spin pairs and produce a current. This current is increased by time and could be detected by Radio-SkyPipe and amperemeter (See figure 9). If we increase number of hexagonal and pentagonal magnets, more pairs are emerged and broken by DNA ultrasound waves and more currents are emerged (See figure 10). If we bring another vessel of milk near first one, bacteria within two vessels communicate with each other and more ultrasound waves are emerged which lead to an increase in observed currents in figure 10.

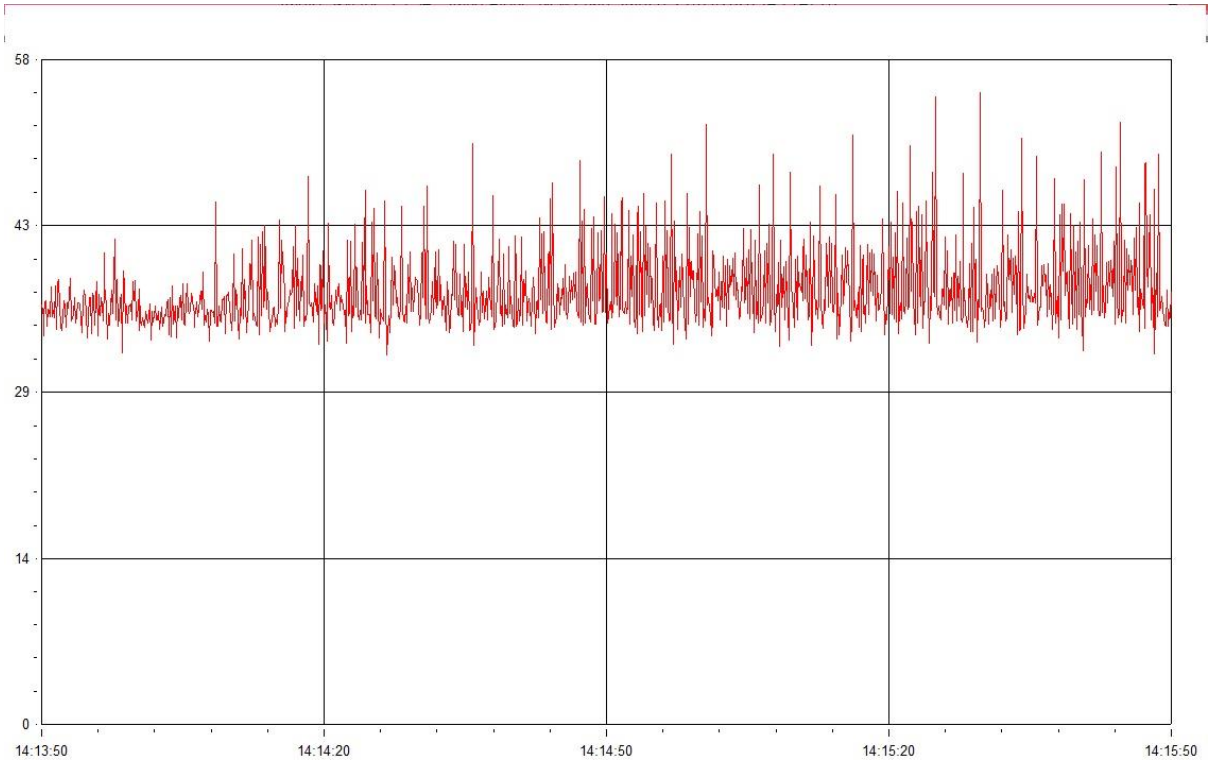

Fig 9: Signals of bacterial DNA ultrasound waves

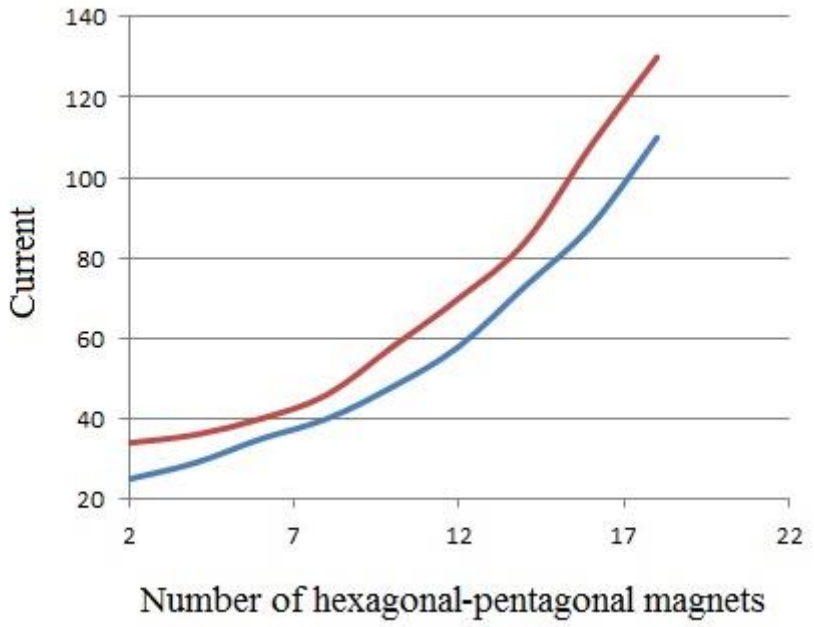

Fig 10: Comparing currents which are taken by the circuit for one vessel (blue color) and two vessels of milk (red color)

V. Conclusions:

In this research, we have proposed a model which let us to estimate the frequency and the wavelength of DNA ultrasound waves and determine their shapes. In this model, a DNA within a cell plays the role of an inductor within a speaker/microphone. On the other hand, charged particles within and out of nucleus produce some electrical fields. These fields produce some currents along nuclear membrane and change it to a magnet which produces magnetic waves. These waves interact with the DNA inductor and leads to its motion. By motion of this DNA, its charged particles move and produce some currents. These currents emit some electromagnetic waves. These waves lead to the vibration of nuclear membrane and production of some ultrasound waves. In addition, we have shown that the structure of a DNA could divide into linear and curved inductors. Linear inductors produce linear ultrasound waves and curved inductors produce curved ultrasound waves. Also, DNA inductors are built from hexagonal and pentagonal bases and by their vibrations, hexagonal/pentagonal ultrasound waves are emerged.

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