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Ministry of Higher Education and Scientific Research University of Diyala−College of Science Department of Physics

The Effect of Magnetized Nutrition on Bone Density

A Thesis Submitted to the Council of the College of Science University of Diyala in Partial Fulfillment of The Requirements for the Degree of M.Sc. in Physics

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بسم الله الرحمن الرحيم

وفوق كل ذي علم عليم

صدق الله العظيم

Dedication

To my wonderful and greatest Mother and father that support, and encouragement to raise me to be the person I am today.....

To my greatest Husband Saif

To my greatest sister manar and my Brother Thoualfeqar.....

To my lovely Ali, Karam and yuser.....

With my love and regard for all support that provides to me in all my life.

Nour

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Nour

CERTIFICATION

We certify that this thesis entitled ***"The effect of magnetized nutrition on bone density"*** was prepared by ***(Nour Abdalrazaq Hassan)*** under our supervision at the University of Diyala / College of Sciences / Department of Physics as a partial fulfillment of the requirements for the Degree of Master of science in Physics.

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Publications research

- **Evaluation the Effect of Magnetized Water on The Bone Density And Osteoporosis In The Experimental Rats By DXAScan**

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- **Evaluation The Effect of Magnetized green tea on The Bone Density And Osteoporosis In The Experimental Rats By DXA-Scan.**

Nour Abd Alrazaq Hassan (BSc)[1], **Tahseen Hussain Mubarak** (PhD)[2] **and Nameer Fadhel Gheaeb** (PhD)[3]

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List of Symbols and Abbreviations

Symbol	Description
i	Current
H	Magnetic field
r	Radial
B	Density of magnetic flux
Jf	Electric current density
m	Magnetic moment
n	Individual loops
V	Voltage
l	Wire length
Φ	Flux
v	Velocity
EF	Electric Field
dA	Area
dt	Time
Wb	Weber
DC	Direct current
AC	Alternating current
V-I	Voltage-Current

Symbol	Description
EMF	Electromagnetic field
q	Static charged partical
BMSCs	Bone marrow stromal cell
hBMSCs	Human bone marrow stromal cell
J	Current density
PEMF	Pulsed electromagnetic filed
ALP	Alkaline phosphates
FACS	Florescence activated cell sorting
CaP	Calcium phosphate
TCP	Tricalciume phosphate
OPG	Osteoprotegerin
CT	Computed tomography
QCT	Quantitative Computed tomography
VAT	Visceral adipose tissue
λ	Wave length
SAT	Subcutaneous adipose tissue
DXA	Dual X ray absorptiometry
BMC	Bone mineral content
BMD	Bone mineral density

Symbol	Description
BA	Bone area
aBMD	Areal bone mineral density
FM	Fat mass
LSTM	Lean soft tissue mass
FFM	Fat free mass
STM	Soft tissue mass
XRD	X- ray diffraction
FTIR	Furrier Transform Infra Red
AFM	Atomic Force Microscope

List of Scheme

Abstract

Magnetized nutrition had effects on regeneration and healing of bone. The amount of this effect depends on the power density and frequency of the electromagnetic field. The properties of the nutrition change when exposed to the magnetic fields. Electromagnetic field easy to penetrate the wall of the cell and increase the speed of deployment.

This study used to estimation the impact of magnetized nutrition on bone density and simultaneous action bone turnover process in rats, and effect on the Healing of Bones fractures in less time.

Eighty males and females adult Wister rats (Rathus Norvegius) were used in this study. Magnetized nutrition is prepared by the electromagnetic system was made in physics labs by student which consist of a iron tube wrapped around a 7000-cylinder roll wire and supplied with a constant current at 220 volts.

In the experiment, a Gauss meter was used to measure the magnetic flow. The DXA scan technique was used to measure bone mineral density (BMD), bone mineral content BMC, T-score and Z-score was used, In addition the dental X-ray machine was used to estimate the healing of bane fracture.

A comparison of bone mineral density, bone mineral content, T-score and Z-score. It was concluded that after 21 days of continuous consumption of magnetized nutrition's leads to intensification of bone regeneration and construction, in addition to the healing of the fractured bone which was obtained after 14 day of continuous consumption of magnetized nutrition`s.

Spss analysis was used to analyze the results and the analysis showed that the results were highly significant, where The collected information to a statistical analysis. The results obtained are presented here

based on SPSS Statistics generates tables in one-way ANOVA analysis and Tukey post hoc test.

Keywords: *Electromagnetic field, Bone density meter in rats, Osteoporosis, Bone regeneration.*

Chapter One

Introduction and previous studies

1.1 Introduction

During the last contracts there was an increasing interestin the bio effects of the electromagnetic fields interaction. The biological effects of synthetically alternative current with 50 Hz standard frequency have been much debated in the context of the biological allergy to extremely low frequency magnetic field (ELF-MF) **[1]**. All living organisms are incessantly exposed to electromagnetic fields from synthetically and domestic sources. It seems clay now that electromagnetic exposure an inductions biological changes, although the precise effects are not yet well known **[2]**. In recent decades, many scientific research have confirmed that magnetic fields of extremely low frequency (ELF; frequency <300 Hz) can influence the biological systems. Data reported in the literature regarding direct effects induced by ELF-MF on cell functions are controversial and the interaction mechanisms of electromagnetic fields with biological systems are still partially understood **[3]**.

Magnetic fields quantities have been characterized by both strength and direction. The strength of a magnetic field is measured in units of tesla in the SI units, and in gauss in the cgs system of units, 10,000 gauss are equal to one tesla. The measurements of the Earth's Introduction magnetic field are often quoted in units of nano tesla (nT), also called a gamma **[4]**.

Electromagnetic fields composed of waves that transport the energy through the space characterized by wave length and frequency, the two of which are inversely correlated. The shorter the wavelength, the greater the frequency **[5]**.

Osteoporosis is an important systemic commotion, affecting mainly Caucasian women, with a variety and multi factorial etiology. A large variety of animal species, including rodents, rabbits, dogs, and primates, have been used as animal exemplars in osteoporosis research. Among these, the laboratory rat is the favored animal for most researchers. Its skeleton has been studied large-scale, and although there are several limitations to its similarity to the human condition, these can be over come through detailed know ledge of its specific rates or with certain techniques. The rat has been used in many experimental protocols leading to bone loss, including hormonal interventions (ovariectomy, orchidectomy, hypophysectomy, parathyroidectomy), immobilization, and dietary manipulations. In addition, several methods of bone mass evaluation are assessed, such as biochemical markers, densitometry, histomorphometry, and bone mechanical testing, that are used for monitoring and evaluation of this animal model in preventive or therapeutic strategies for osteoporosis **[6]**.

1.2 Literature review

Yacout, et.al. (2015) conducted that treatment water properties could be changed to become more energized, active, soft and high pH toward slight alkaline and free of germs **[7]**.

Alhassani and Amin. (2012) Several reports are available on the application of water magnetization on broiler production **[8]**.

Rona. (2004) found that using magnetic drinking water for chickens resulted in shortening of fattening period of broiler chickens, an increase in growth rate by 5-7 %, improving meat quality, flavor and tenderness **[9]**.

Mak and Zhang. (2001) They mechanical forces have been known to affect molecular signaling and molecules in bone cells via mechanic transduction **[10]**.

Yoshida, et. al. (2009) found that the conversion of mechanical loads to bioelectric signals (i.e., pressure generated potentials also known as piezoelectricity) in bone has been suggested to control repair and remodeling **[11]**.

Guzelsu and Walsh. (1990) stated that the signals are attributed to electrically-generated kinetic behavior where mechanical forces generate electrical signals due to the motion of ion-carrying extracellular fluid in the bone matrix. The effect is known as streaming potential **[12]**.

Sun, et. al. (**2007)** showed that a direct current (DC) 0.1 (V/cm) stimulus 30 (min/day) for 10 days enhanced expression of osteogenic factors for hBMSC differentiation into the osteogenic cell lineage by reducing the Ca^{2+} wave frequency typically found in the differentiation process**[13]**.

Tsai, et. al. (2009) found Increased cell numbers were observed at late stages of osteogenic culture with this same PEMF exposure. The production of ALP, an early marker of osteogenesis, was significantly enhanced at 7 day when exposed to PEMF treatment in both basal and osteogenic cultures as compared to untreated controls. Furthermore, the expression of a key osteogenic regulatory gene *RUNX2/CBFA1* and ALP, was also partially modulated by PEMF exposure, indicating that osteogenesis in hBMSCs was associated with the specific PEMF stimulation **[14]**.

Tsai, et. al. (2007) reported similar results when they isolated hBMSCs from adult patients and cultured them in osteogenic medium for up to 28 days. Using aPEMF stimulation of 7.5 (Hz), greater cell numbers were observed compared with controls. The production of ALP was significantly enhanced at 7 day on both basal and osteogenic cultures as compared to untreated controls. Also the expression of early osteogenic genes RUNX2/CBFA1 and ALP was indicative of PEMF stimulation. ALP accumulation produced by the hBMSCs, along with Ca^{2+} deposits reached their highest levels at 28day **[15]**.

Kim, et. al. (2015) EMF alone, and in combination with nano magnetic particles (MPs), has also been used to promote the differentiation potential of hBMSCs. investigated the effect of both EMF and MPs on hBMSCs by treating them with 50 μg/ml of Fe3O4 MPs and/or an exposure of 45 Hz, 1 mT intensity EMF The cells were exposed to EMF twice every 8 (h/day) for 7 days. The treatment with MP, and/or then exposure to EMF did not cause cytotoxic effects. The strong expression of osteogenic markers OSTEOCALCIN, OSTEOPONTIN, and OSTEONECTIN was observed in the cells treated with

MPs, EMF alone, MP alone, or a combination of MP and EMF, as compared with controls. The quantitative RT-PCR revealed that mRNA expression levels of OSTEOCALCIN,OSTEOPONTIN, OSTEONECTIN,COLLAGEN I (COL1A1),COLLAGEN III (COL3A1),BONE MORPHOGENETIC PROTEIN 2 (BMP2),BONE SIALOPROTEIN (IBSP), and RUNX2 were significantly increased in cells treated with MPs, than those exposed to EMF**[15]**.

De Mattei, et. al. (1999); Lohmann, et. al. (2000); Schwartz, et. al. (2008); Sun, et. al. (2009); Trock DH, et. al. (1993); Tsai, et. al. (2007); Tsai, et. al. (2009) The Frequencies used thus far for stimulating and enhancing osteogenesis have varied from 7.5 to 75 (Hz), and have revealed that not only frequency, but also the direction of the EMF makes a difference in the results. The hBMSCs exposed to positive 30/45 (Hz), 1 (mT) and negative 7.5 (Hz), 1 (mT) EMF for osteogenic differentiation reported increases in ALP mRNA expression **[17- 18- 19- 20- 21- 14- 15]**.

Poon, et. al. (1995) The indication that the effect of EMF on osteogenic differentiation is significantly dependent on the direction of the EMF exposure. It is important to point out that the effects occurring at 7.5, 15, 45, and 75 (Hz) are harmonic waves and these pulsed patterns going from lower to higher order harmonics cause a decrease in relative energy states **[22]**.

Bianco, et. al. (2013) Results suggest that EMF promotion of bone ECM deposition in vitro is more far more efficient in osteoblasts differentiated from hBMSCs than from cells of other tissues **[23]**.

Sun, et. al. (2009) have investigated the effect of PEMF on the proliferation and differentiation potential of human hBMSCs. EMF stimulus was administered to cells for 8 h per day during the culture period. The EMF applied consisted of 4.5 (m sec) bursts repeating at 15 (Hz), and each burst contained 20 pulses. Results showed 59% more viable hBMSCs were obtained in the EMF-exposed cultures at 24 (h) after plating and 20–60% higher cell densities were achieved during the exponentially expanding stage. Many newly divided cells appeared from 12 to 16 (h) after the EMF treatment; however, cytochemical assays and immunofluorescence analysis showed multiline age differentiation of EMF-exposed hBMSCs to be similar to that of the control group, which used only standard growth media **[20]**.

Saino, et. al. (2011) tested the effects of EMF on hBMSCs seeded on gelatin cryogel disks and compared with control conditions without EMF stimulus. Treatment with EMF (at 2 (mT) intensity and 75 (Hz) frequency) increased the cell proliferation and differentiation, as well as enhanced the biomaterial surface coating with bone ECM proteins Using this approach, the gelatin biomaterial, coated with differentiated cells and their ECM proteins, has the potential to be used in clinical applications as an implant for bone defect repair. for example, under the appropriate culture conditions, PEMF enhances the osteogenic effects of BMP-2 on hBMSCs. Thus, PEMF could potentially be used clinically to stimulate bone formation from transplanted hBMSCs **[24]**.

Schwartz, et. al. (2009) they specific suggests investigating whether the effects of PEMF on osteogenic cells were substrate dependent, and could also regulate osteoclastic bone resorption. treated hBMSCs and human osteosarcoma cell lines (MG63 cells, SaOS-2 cells) capable of osteoblastic differentiation with BMP-2, then cultured them on calcium phosphate (CaP) or tricalcium phosphate (TCP) to test their response to a 15 Hz PEMF at either 4.5 (m sec) bursts or 20 pulses repeated for 8 (h/day). Outcomes were determined to be a function of the decoy receptor, osteoproteger in (OPG), and RANK ligand (RANKL) production both of which are associated with the regulation of osteoclast differentiation. Results suggested that when osteogenic cells were cultured on CaP, PEM decreased cell number and increased production of paracrine factors associated with reduced bone resorption such as OPG. RANKL was unaffected, indicating that the OPG/RANKL ratio was increased, further supporting a surface-dependent osteogenic effect of PEMF. Moreover, effects of estrogen were surface-dependent and enhanced by PEMF, demonstrating that PEMF can modulate osteogenic responses to anabolic regulators of osteoblast function Therefore, PEMF shows promising results when used in conjunction with complex 3-D cell culture systems as a strategy for tissue engineering approaches **[25]**.

1.3 Aim of the study

- Estimate the impact of magnetized nutrition on living bone density and bone turnover process in rats by means of analysis bone density.
- Study the impact of electromagnetic field on magnetized nutrition.
- Study of the effect of magnetic nutrition on the healing of broken bones.

Chapter Two

Theoretical Background

2.1 The Magnetic Field

"Magnetic fields" similar to gravitational fields, cannot be seized or touched. One can feel the attracts of the Earth's gravitational field on ourselves and the bodies around us **[26].**

No skill of magnetic fields in such a direct path. The existence of magnetic fields can be recognized by their effect on objects, such as magnetized bits of mineral, naturally magnetic crags such as magnet, or temporary magnets such as copper coils that lades an electrical current. Placing magnetized needle on a cork in a pail of water, will slowly line-up itself with the local magnetic field **[27]**.

Turning on the current in a copper wire can make a nearby compass needle prances. Feedback like these driven to the development of the understandable of magnetic fields.

The electric currents mark magnetic fields, so we can explain what is implies by a "magnetic field" in terms of the electric current that produces it. Figure (2.1a) is a picture of what happens when we pierce a uniform sheet with a wire conceiving a current *i*. When iron filings are strewn on the leaf, the filings juxtaposition with the magnetic field formed by the current in the wire.

The loop tangential to the field is revealed in Figure (2.1b), **[26]** which shows the *right-hand rule*. If your right namelessness points in the course of (positive) current flow (the direction reverse to the flow of the electrons), your fingers will curl in the direction of the magnetic field.

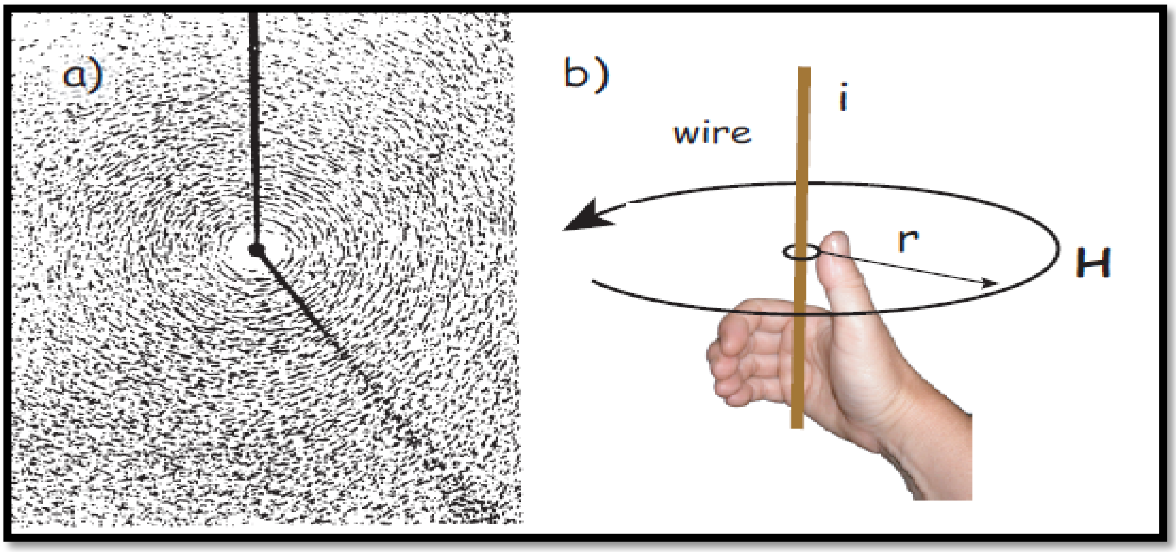


Figure 2.1 a) Distribution of iron filings on a flat sheet pierced by a wire carrying a current *i*. [26].

b) Relationship of magnetic field to current for straight wire.

The magnetic field **H** points at right angles to both the direction of current low and to the radial vector **r** in Figure (2.1b). The magnitude of **H** (denoted H) is proportional to the strength of the current i. In the simple case illustrated in Figure 2.1b, the magnitude of **H** is given by Amp`ere's law:

$$\mathbf{H} = \frac{\mathbf{i}}{\mathbf{2\pi r}} \qquad \text{…… (2.1)}$$

Where is the length of the vector **r**. So now we know the units of *H*: (Am^{-1}). Amp`ere's Law, in its most general form, is one of Maxwell's equations of electromagnetism a steady electrical field:

$$\nabla \times \mathbf{H} = \mathbf{Jf} \qquad \text{……. (2.2)}$$

where **J***f* is the electric current density. In words, the curl (or circulation) of the magnetic field is equal to the current density. The origin of the term "curl" for the cross product of the gradient operator with a vector field is suggested in Figure (2.1a), in which the iron filings seem to curl around the wire.

2.2 Magnetic Moment

The electrical current in a wire produces a magnetic field that "curls" around the wire. when the wire bended into a loop with an area ($2\pi r$) that carries a current *i* Figure 2.2a, the current loop would create the magnetic field shown by the variable of the iron filings.

This magnetic field is the same as the field that would be produced by a permanent magnet. The specific strength of that hypothetical magnet in conditions of a magnetic moment m Figure (2.2b). The magnetic moment is created by a current *i* and also accredits on the area of the current loop (the bigger the loop, the greatest the moment). Therefore, the magnitude of the moment can be quantified by:

$$\mathbf{m = i\pi r^2} \qquad \ldots\ldots (2.3)$$

The moment created by a specify of loops as shown in Figure (2.2c) would be the sum of the ***n*** individual loops:

$$\mathbf{m = ni\pi r^2} \qquad \ldots\ldots (2.4)$$

So, the units of m:Am^2. In addition, magnetic moments are carried by magnetic minerals, the most rumor of which are magnetite and hematite.

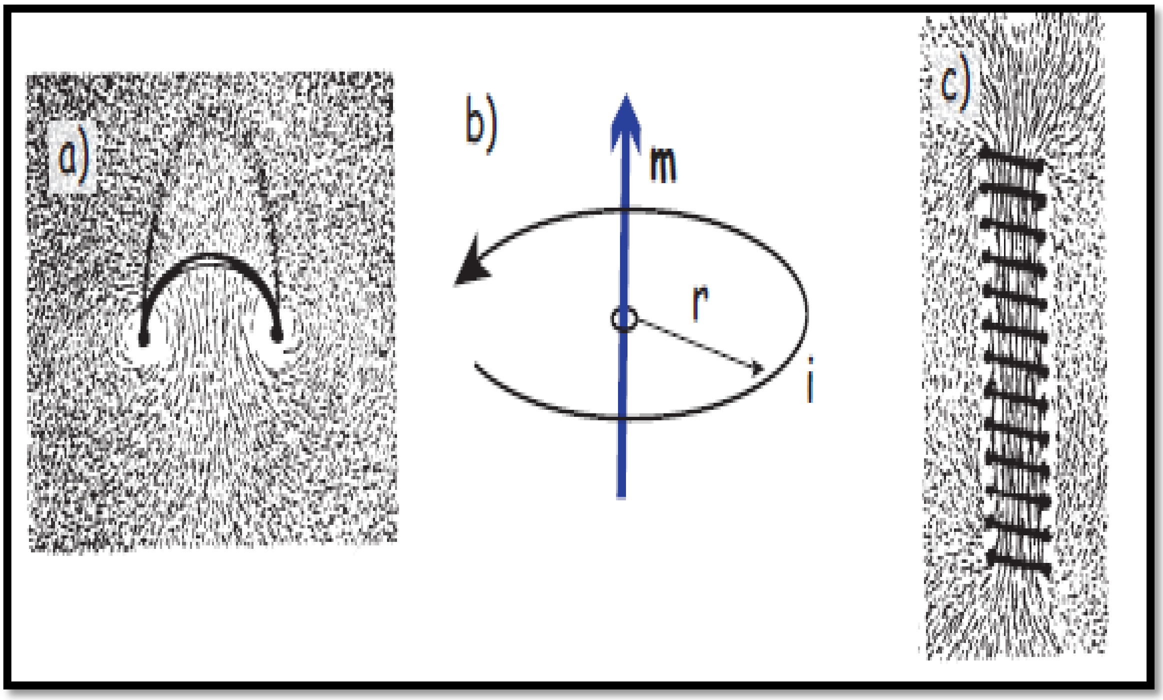


Figure 2.2 a) Iron filings show the magnetic field generated by current flowing in a loop, b) A current loop with current i and area πr^2 produces a magnetic moment m and c) The magnetic field of loops arranged as a solenoid is the sum of the contribution of the individual loops. [26].

2.3 Magnetic Flux

The magnetic field is a vector field because, at any point, it has both direction and magnitude. deem the field of the bar magnet in Figure 2.3a. The direction of the field at any point is given by the arrows, while the strength depends on how close the field lines are to one another. The magnetic field lines represent *magnetic flux*. The density of flux lines is one measure of the strength of the magnetic field the magnetic induction **B** **[28]**.

Just as the motion of electrically charged particles in a wire (a current) creates a magnetic field (Amp`ere's Law), the move of a magnetic field creates electric currents in nearby wires. The stronger the magnetic field, the stronger the current in the wire.

The measured strength of the magnetic induction (the density of magnetic flux lines) by moving a conductive wire through the magnetic field

Figure (2.3b). Magnetic induction can be thought of as something that creates a potential difference with voltage *V* in a conductor of length *l* when the conductor moves relative to the magnetic induction *B* with velocity v Figure (2.3b).

$$\mathbf{V = vlB} \qquad \text{...... (2.5)}$$

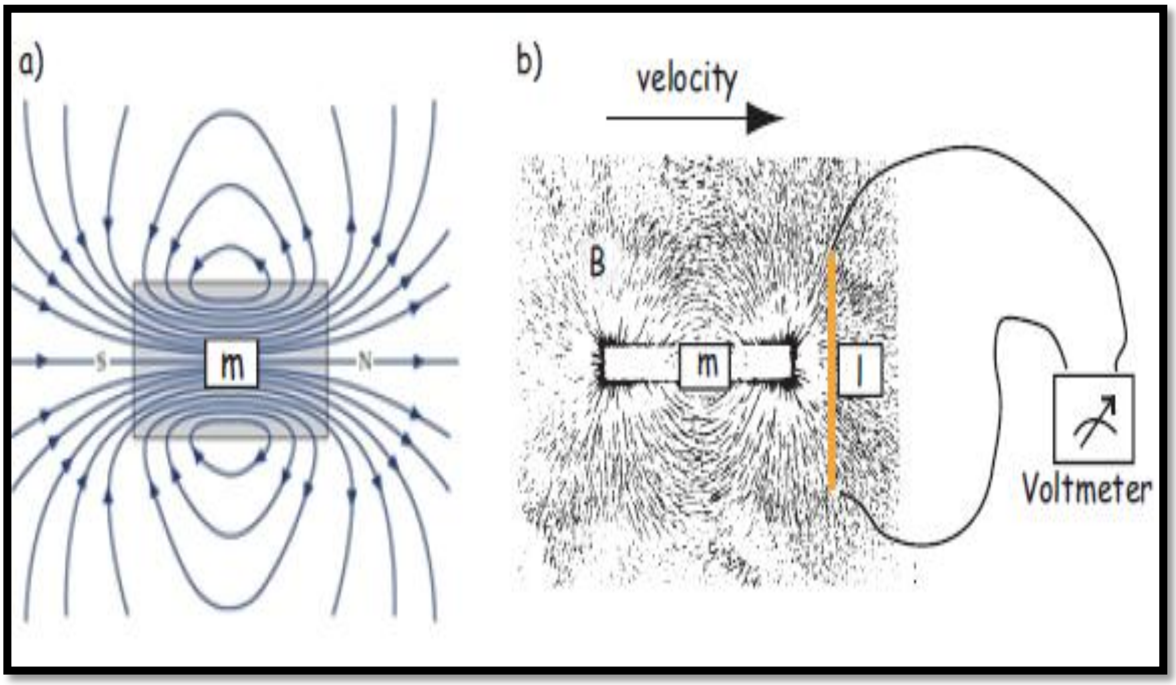


Figure 2.3 a) A magnetic moment makes a vector field B. The lines of flux are represented by the arrows [28]. and b) A magnetic moment m makes a vector field B, made visible by the iron filings. If this field moves with velocity v, it generates a voltage *V* in an electrical conductor of length *l*. [26].

From this, we can derive the unit of magnetic induction the tesla (T). One tesla is the magnetic induction that generates a potential of 1 volt in a conductor of length1 meter when moving at a rate of 1meter per second. So now we know the units of **B**: ($Vs{\cdot}m^{-2}$) = (Tesla)

B is that if magnetic induction is the density of magnetic flux lines, it must be the flux Φ per unit area. So an increment of flux *d*Φ is the field magnitude B times the increment of area *dA*. The area here is the length of the wire *l* times its displacement *ds* in time *dt*. The instantaneous velocity is $dv = ds/dt$, so $d\Phi = BdA$, and the rate of change of flux is:

$$\frac{d\Phi}{dt} = \frac{ds}{dt} Bl = vBl = V \qquad \text{……(2.6)}$$

Equation (2.6) is known as Faraday's Law and, in its most general form, is the fourth of Maxwell's equations. Equation (2.6) shows that units of magnetic flux must be a volt-second, which is a unit in its own right the weber (Wb).

The weber is defined as the amount of magnetic flux which, when passed through a one-turn coil of a conductor carrying a currentof1 ampere, produces an electric potential of 1 (volt). The definition suggests a means to measure the strength of magnetic induction and is the basis of the "fluxgate" magnetometer.

2.4 Defining electromagnetic field parameters

The cellular effects by either self-growth or external origin fields, it is important to define the nomenclature. The term electromagnetic field is used to summarize the whole field, which includes "electric," "magnetic" and combined "electromagnetic" effects. Electric field (EF) includes a current that can be either direct (DC) or alternating (AC) **[29]**.

Electric current units are measured in amperes (A). Electrical potential differences are measured in volts (V). Units of magnetic flux density (intensity) are measured in either Gauss (G), or Tesla (T), which is 10,000 G show Table (2.1).

Table 2.1 Types of electric, magnetic and electromagnetic fields.

Field type	Type	Potential difference	Intensity
Electric	Direct (DC) or alternating (AC)	Current	Ampers
Magnetic	Static or time. Varying	Volt	Gauss or tesla
Electromagnetic	Static or pulsed	Volt	Gauss or tesla

Faraday's law of induction and Maxwell's equations explain how an EMF(electromagnetic field)is generated. A static electric field is generated by a static charged particle (q). The electric field (or E component of an EMF) exists whenever charge (Q) is present. Its strength is measured in volts per meter (V/m), and expressed as intensity for field strength.

The electric field of 1 (V/m) is characterized by a potential difference of 1 (V) present between two points that are 1 (m) separately. The magnetic field (or M element of an EMF) arises from current flow. The Tesla (or Gauss) is primarily used to fast the flux density or field strength produced by the MF. Both EFs and MFs are created if a charged particle moves at fixed velocity. Congregating they generate an EMF when the charged particle is accelerated.

The acceleration takes place in the form of an oscillation, therefore electric and magnetic fields often oscillate. The change in the EF creates an MF, and any change in the MF creates an EF. This interaction suggests the higher the frequency of oscillation, the more the electric and magnetic fields are mutually coupled.

The EMF can affect biochemical reactions and the behavior of charged molecules near cell membranes. The magnetic field can influence cell behavior by: exerting force on moving charge carriers such as ions generating electric fields in conductive substances changing the rate of diffusion cross membranes **[29]** and distorting bond angles, which affects protein structure binding and therefore macromolecule synthesis **[30]**. Unlike Electronic Field, which are shielded by the high dielectric properties of the cell membrane, magnetic gradients penetrate deeper through layers of living tissue **[31]**, acting directly on cell organelles. The Pulsing of the EMF causes a rise and fall in ion fluxes, whereby changes in the membrane potential cause an inward current flow resulting in hyperpolarization of its potential **[32]**.

Depending on the parameters involved in the EMF treatment, and the biological process in question, either stimulation or inhibition can occur. In contrast to the membrane, the cytoplasm or fluids in extracellular spaces, contain no free electrons to carry charge, so current is carried by charged ions such as Na^{+}, K^{+}, and Ca^{2+}.The resistivity of the solution can be measured, and is typically ~100 ohms (Ω) **[33]**.

2.5 Magnetic behavior of material

According to the modern theory, magnetism in solids arises due to orbital and spin motion of electrons as well as spin of the nuclei. The motion of electron is equivalent to an electric current which produces the magnetic effects. The major contribution comes from the spin of unpaired valance electrons which produces permanent electronic magnetic moments **[34]**.

A amount of such magnetic moments may align themselves to create a net non-zero magnetic moment, with or without the application of magnetic field. Thus; the nature of magnetization produced depends on the number of unpaired valence electrons present in the atoms of the solid and on the relative orientations of the neighbor ring magnetic moments. Periodic table of elements shown in figure (2.4). The magne- tism in solids has been classified into the following six categories:

1- Diamagnetism

2- Paramagnetism

3- Ferromagnetism

4- Antiferomagnetism

5- Ferrimagnetism

6- Superparamagnetism

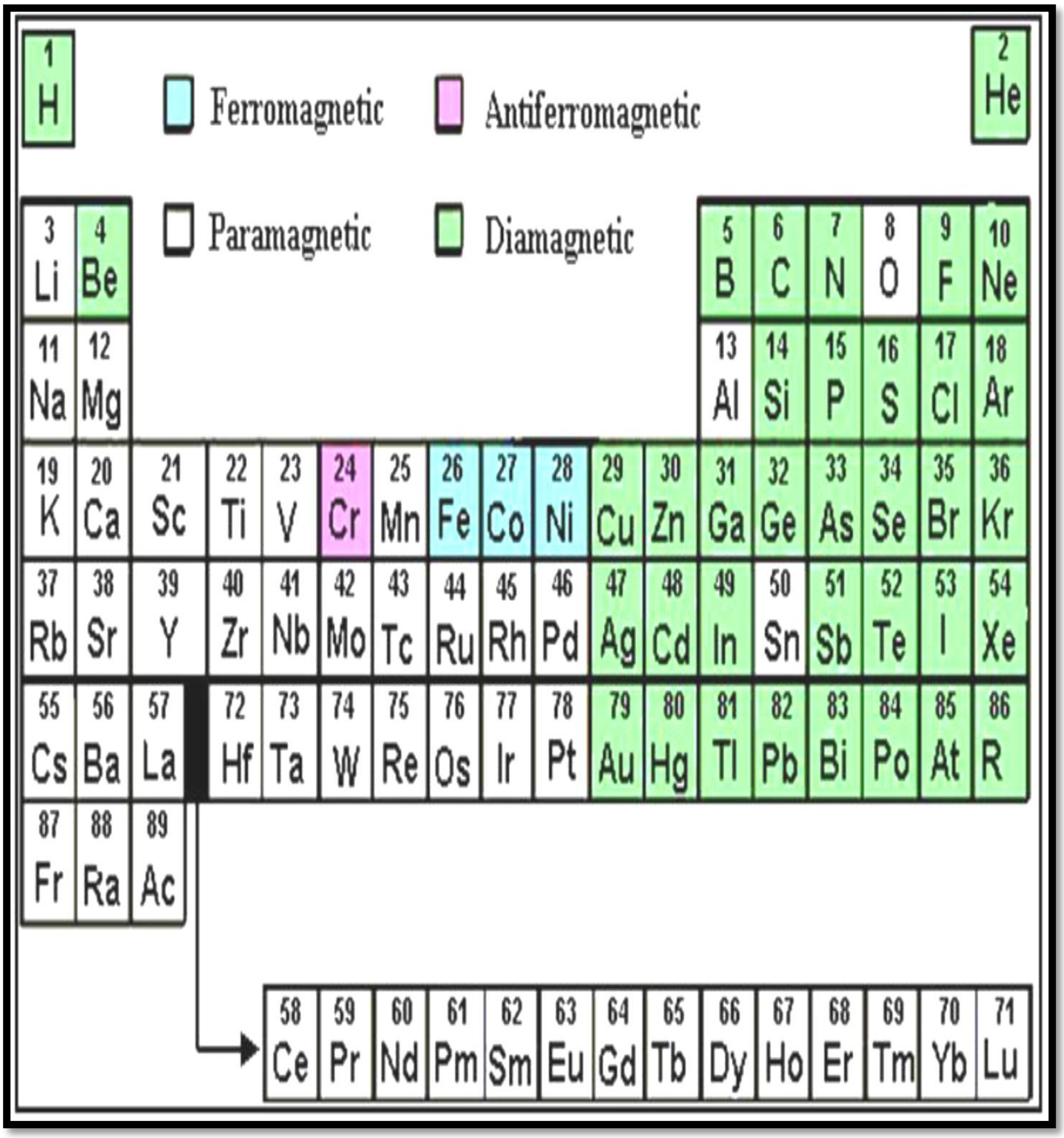


Figure 2.4 Periodic table showing different kinds of magnetic materials [35].

1-Diamagnetism is a very weak affect exhibited in solids, where the magnetic moments are always directed opposite to the applied magnetic field. The existence of a small non-zero magnetic moment in these materials is attributed to the orbital motion of the electrons **[34]**.

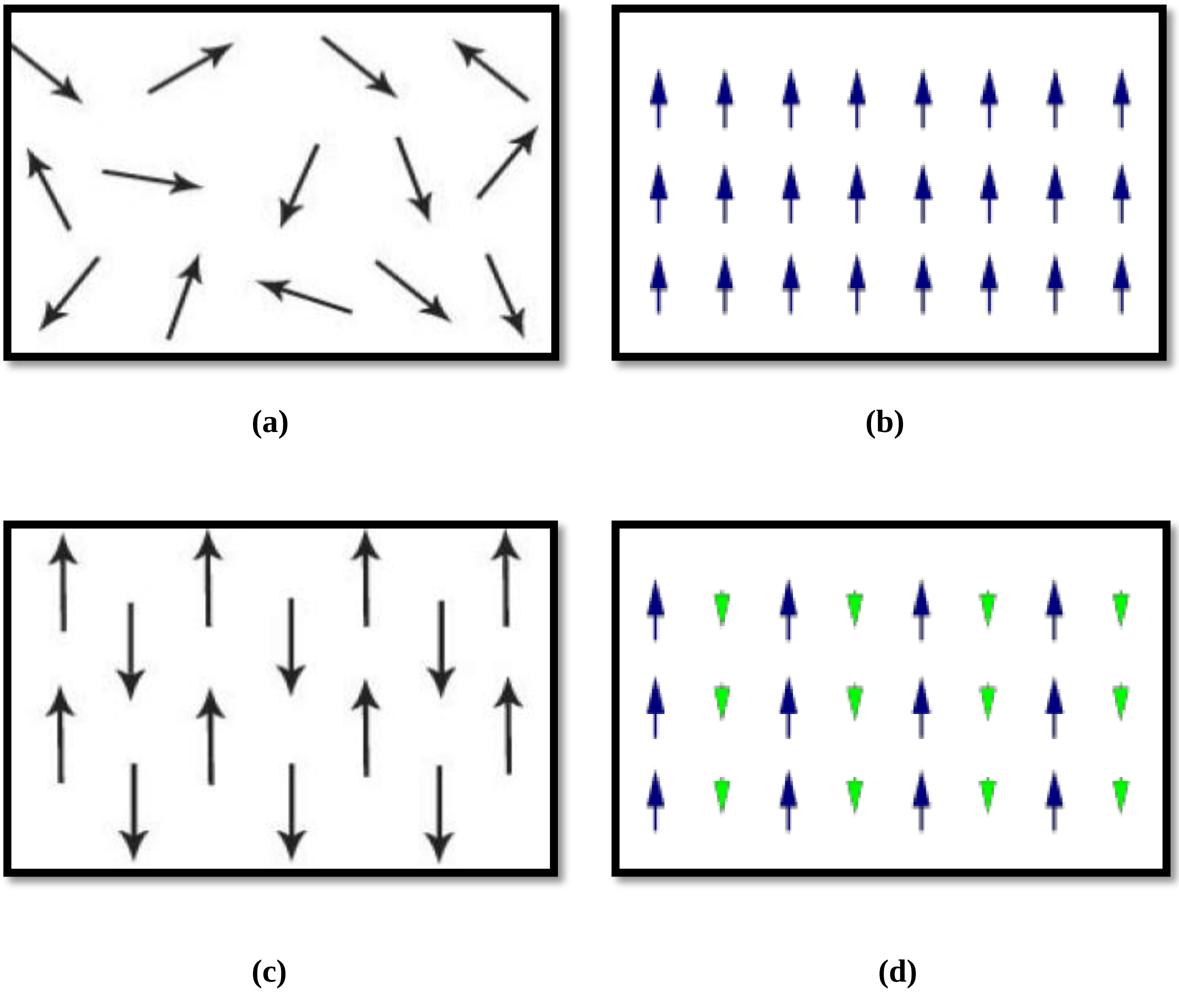
2-Paramagnetism arises due to the presence of permanent atomic or electronic magnetic moment. It is also a weak affect but unlike diamagnetism, the magnetic moment is aligned in the direction of the field **[34]**.

3-Ferromagnetism is a very strong affect and arises when the adjacent magnetic moment align themselves in the same direction with in a small region called domains. The domains aligned in the applied magnetic field direction resulting an enhancement of total magnetization value **[34]**.

4-Antiferromagnetism the adjacent magnetic moments are equal and opposite to each other and hence complete cancellation of moments take place **[34]**.

5-Ferrimagnetism is similar to antiferromagnetism, but except that adjacent moments are unequal in magnitude and hence complete cancellation of moment does not takes place **[34]**.

Since susceptibility is the essential physical parameter, for under-standing various magnetic materials. It is relevant to study the measurement of susceptibility. The magnetic dipole alignment for behaviors of magnetic materials shown in below figures:



(a) (b)

(c) (d)

Figure 2.5: The magnetic dipole alignment of (a) paramagnets, (b) ferromagnets, (c) antiferromagnets and (d) ferrimagnets respectively.

6-Superparamagnetism is a form of magnetism, which appears in small ferromagnetic or ferromagnetic nanoparticles. In small enough nano particles, magnetization can randomly flip direction under the influence of temperature. The typical time between two flips is called the Néel relaxation time. In the absence of external magnetic field, when the time used to measure the magnetization of the nanoparticles is much longer than the Néel relaxation time, their magnetization appears to be in average zero: they are said to be in the superparamagnetic state. In this state, an external magnetic field is able to magnetize the nanoparticles, similarly to a paramagnet. However, their magnetic susceptibility is much larger than the one of paramagnets. This phenomenon is called "superparamagnetism" because, as a result of this competition between anisotropy and thermal energies, assemblies of small particles show magnetization behavior that is qualitatively similar to that of local moment paramagnetic materials, but with a much larger magnetic moment **[37]**.

2.6 Magnetization curve and the hysteresis loop

Only ferromagnetic and ferrimagnetic, among other materials, show nonlinear relation between the magnetization M of the sample and the applied field H. The magnetization curve (or the M-H) relation in these materials shown (the dashed curve) in Figure (2.6).

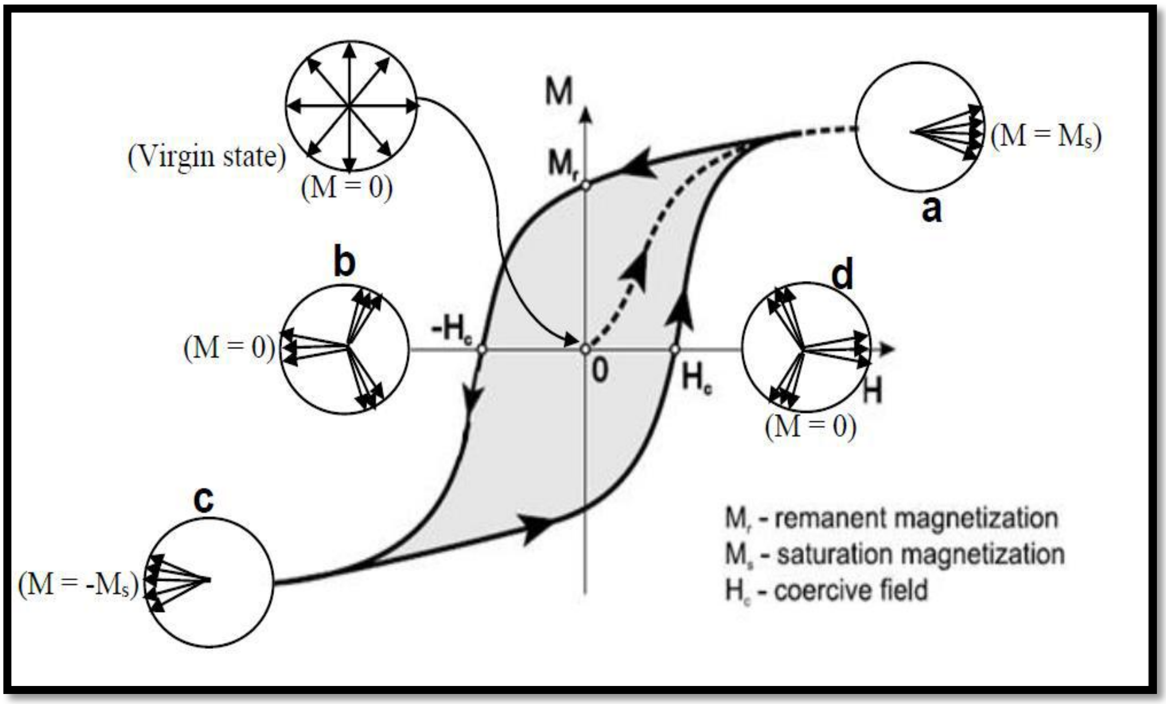


Figure 2.6 Hysteresis loop of ferromagnetic and ferrimagnetic materials [36].

The hysteresis loop (solid curve in Figure (2.6)) illustrates the behavior of the magnetization (M) of the specimen with the variation of the applied field (H).

As H increases, the magnetization increases up to its highest value at (a) as shown in Figure (2.6), this defines an important characteristic parameter of the material, the saturation magnetization (Ms) at high enough applied field. The saturation state is reached by completion of the domain wall motion and domain rotations. The value of the field needed to reach the saturation magnetization depends on the nature of the material, its type, method of preparation, microstructure, and other intrinsic and extrinsic parameters. If we then gradually decrease the applied field, the magnetization decreases due to spin flipping from the forward applied field direction to easy directions close to the forward direction. When the applied field becomes zero, the magnetic moments of the domains will be generally oriented randomly in the forward half-space. Because of this orientation along easy directions in the forward half-space, the magnetization retains a value even at zero applied field, the remnant magnetization or the remanence (Mr).

This parameter has particular importance in the case of permanent magnets production because it defines the magnetization of a magnet in the absence of an applied field. If the applied field is reversed and increased, the magnitude of magnetization will continue to decrease due to the field-induced spin flipping to easy directions close to the reverse direction, tell it dies out at a certain value of the reverse field called the coercivity Hc.

The magnetic moments will become randomly oriented again at (b) but not like the virgin state at the origin. If we want to get the specimen back to the virgin state, we need to demagnetize the specimen through de- magnetizing process. If the reversed field is further increased, the magnetization increases in the reverse direction until it reaches saturation at (c). Upon reducing the reverse field down to zero, the magnetization decreases to the value of –Mr. Then reversing the field to the forward direction and increasing its intensity up to Hc bring the value of magnetization to zero at (d). The saturation magnetization in the forward direction is then reached again at (a) with further increasing the field. The value of the coercive field, the coercivity, defines the magnetic hardness of the material **[36]**.

This phenomenon is called “superparamagnetism” because, as a result of this competition between anisotropy and thermal energies, assemblies of small particles show magnetization behavior that is qualitatively similar to that of local moment paramagnetic materials, but with a much larger magnetic moment **[37]**.

2.7 Magnetized water

The first used in Russia by three specialists: Drs. G. Gerbenshchikow,I. Shetsov and K. Tovstoles. They had their patients drink bi-polar magnetized water. This simple treatment was very effective in breaking up kidney and gall bladder stones into small enough particles to be passed through urine without any pain or danger to the patient. The water also prevented further formation of stones in the kidneys and gallbladder. Soviet physicians have been giving internally magnetized water to patients for over 30 years for digestive, urinary and nervous problems, ailments like mastitis, pains and swellings, painful urination and many other disorders **[38- 39]**.

Exposing of water to strong magnetic fields affected the mineral content of water and its effects depended on the strength of the magnetic field and exposure time. Nowadays, the use of magnets to improve water quality is significant due to low cost compared to chemical and physical treatments. Normal water has a pH around 7, whereas magnetized water can reach pH of 9.2 following the exposure to7000 gauss strength magnet for along period of time **[40]**.

Attia *et al.,* reported that rabbit bucks drank magnetized water showed a significant increase in body weight, feed intake **[41]**.

On the other, hand, feed consumption. showed no significant changes, while metabolic factor increased and body weight decreased only among magnetically treated water group animals, the highest improvement was recorded in water consumption in magnetically treated water groups.

Magnetically treated water makes animals thirsty could be used as a strategy to enhance body hygiene and immune system **[42]**.

Magnetic energy for water plays an important role in organizing all forms of life on the planet by forming a protective shell to prevent lethal cosmic scan like Kama Ray and Scan – Ray , as well as the significant role of organizing vital functions of all organisms **[43]**.

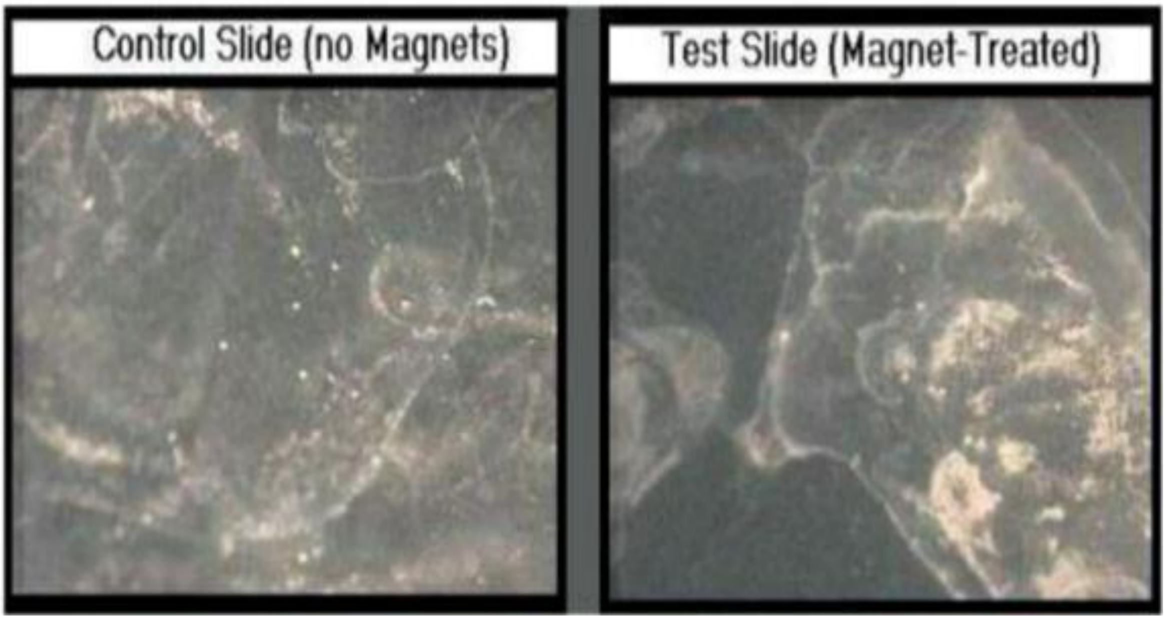


Figure 2.7 shows slides of magnetic and non – magnetic water

Water, component consists of Hydrogen and Oxygen atoms, water molecule in simplest shape, water molecules bond with each other with hydrogen bonds with bilateral or multiple bonds. When water molecules have been put through magnetic field, the hydrogen bonds among molecules either change or disintegrate and that disintegration absorbs the energy, reduces water molecules union increases susceptibility electrolysis, effects on crystals decomposition as well Figure (2.7).

Magnetic field capacity of 1000 magnetic unit increases Ions alternate absorption by 8.5% , while the capacity of 3000 increases this rate to 19% .Substance molecules divide into two kinds either polar as water H_2O or non –

polar as O_2 and H_2, the passage of non – polar molecules through magnetic field leads to charge and transform them into bi- polar as. figure (2.8).

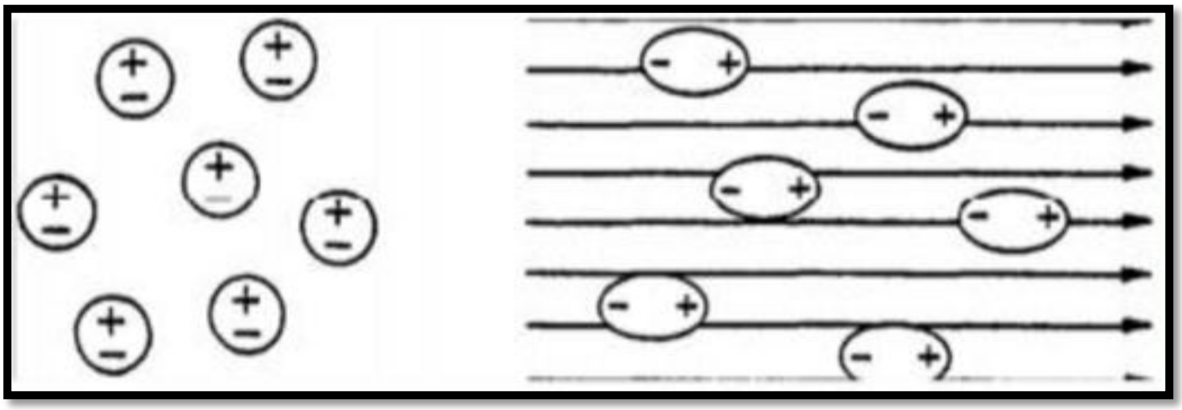


Figure 2.8 shows magnetic field effect on non- polar molecules.

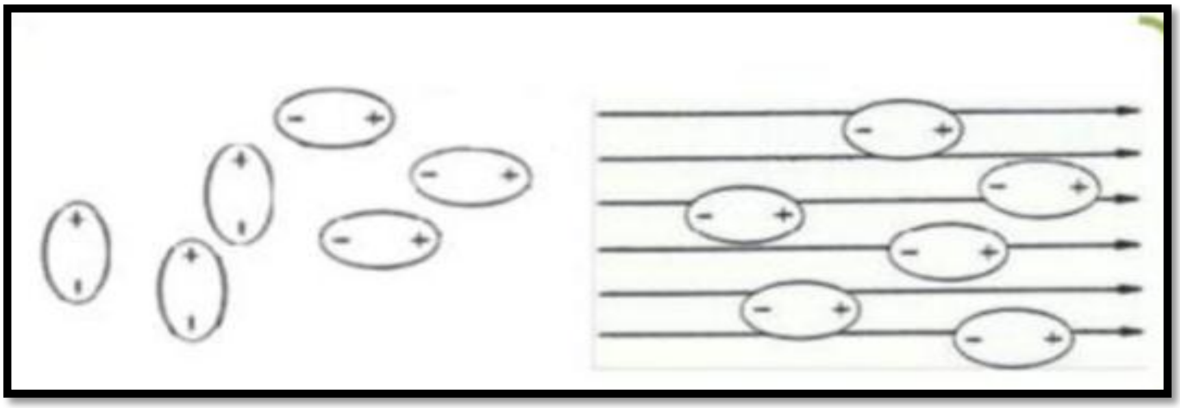


Figure 2.9 shows magnetic field effect on polar molecules.

Polar molecules as water mostly arrange in random way and when being exposed to strong magnetic field large number of scatter molecules move towered magnetic field Figure (2.9). After passing through the magnetic field water molecules rearrange. Figure (2.10).

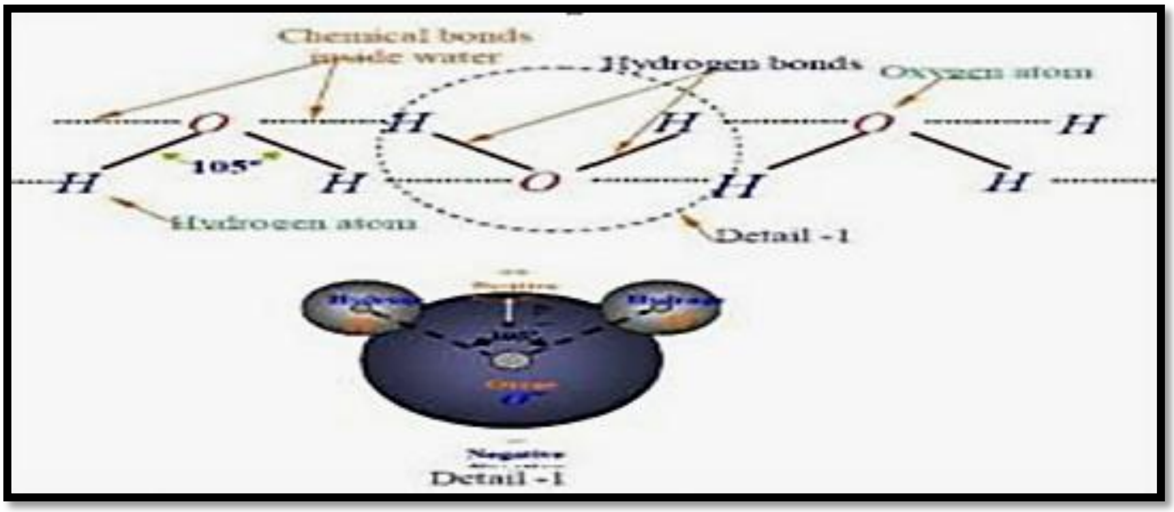


Figure 2.10 shows water molecules.

This kind of oriented arrangement causes drag and break of hydrogen bond and align water molecules to certain direction as passing through magnetic field as well as reduses bond angle to less than 105°. as shows in Figure (2.11) that leading to reduction of molecules union level. On other hand, decreasing in molecules volume resulted from break of hydrogen bond so that some turn to solo- molecules. For that the magnetized water viscosity less than regular water. Also water molecule groups changes accompanied with osmotic pressure, superficial tighten, hydrogenous figure, and water electric connect changes. All these changes occure in different degree may be solo .

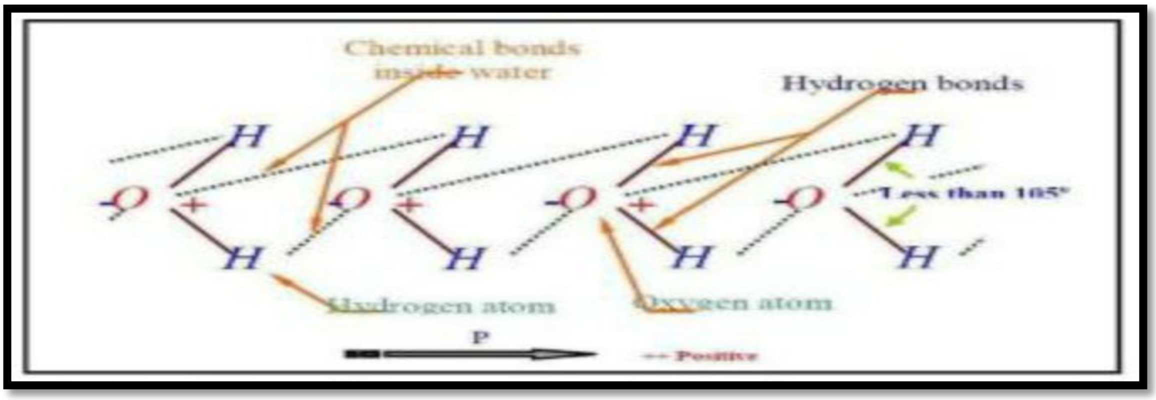


Figure 2.11 shows water molecules arrangement after passing through magnetic field.

2.8 Magnetizing different kind of Tea (green tea with mint extract)

Tea as a vital material consists of numerous components and functional groups within the chemical structure, however via ongoing study the basic components that represented some of Tea chemical structure which is Catechin, Caffaien, theanine, and Gallic Acid found , as shows figure (2.12) components structural formulas [44- 45].

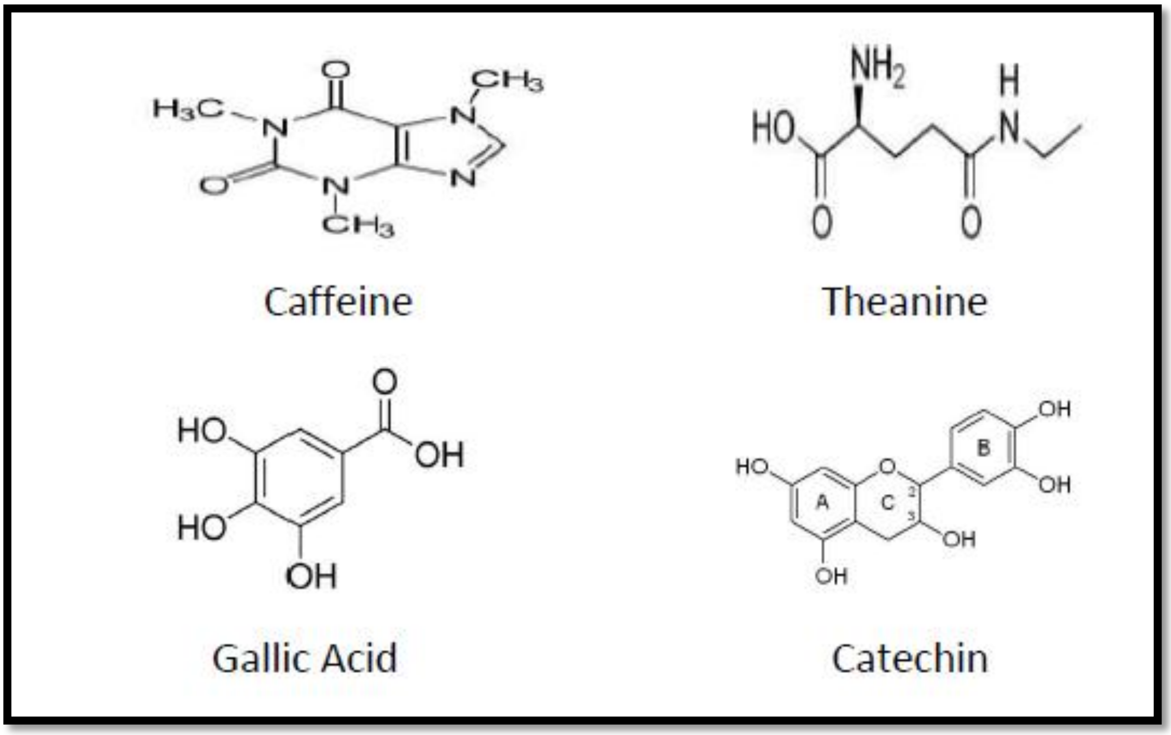


Figure 2.12 shows Tea components structural formulas

2.9 The developmental biology

Developmental biology have recognized key regulators of morphogenetic attributes, and have specified where endogenous EMF is located in the action of heart tissue and nerves potential, and in skeletal muscle shaking, with frequencies aroused by rhythmic activities, throughout the living organism **[46]**. Endogenous EMF frequencies performance on a cell at the molecular level through very low endogenous frequencies **[33]**

The endogenous frequencies that can be tugged to follow exogenous EMF of the similar frequencies. The entrainment (via harmonic resonance) is what influences the differentiation of BMSCs. While there are a multitude of research articles exploring these phenomena, the approaches for gathering these facts include an overwhelming matrix of experimental models, EMF devices, waveforms, and clinical implementation; therefore, a consensus of analogically means for experimentation is greatly wanted to determine which replies directly result from the EMF exposure. Effective EMF stimuli are coherent, airings a series of recurring signals that must be present for a least amount of time **[47]**. This effect is also tissue specific **[48 - 49]**. Therefore, the exact time points during which differentiation occurs under EMF stimuli need to be clarified. While high frequency (900–1800 MHz) EMF, such as that derived from microwave and mobile phone communication, acts through mixtures of modulated and carrier frequencies, research to-date has concentrated primarily on the thermal effects of radiation at a tissue-specific absorption rate known as SAR.

2.10 EMF and osteogenic differentiation of hBMSCs

"Osteogenesis" is a complex sequence of events by which BMSCs differentiate to create new bone. hBMSCs have characteristic Ca^{2+} waves that are participated in intracellular signaling. The waves work in short and long phases, with the longer phases operating during trans-cellular signaling. In the field of intracellular signaling, the oscillation of cytosolic Ca^{2+} is perhaps one of the most imperative findings **[50]**.

Research into the molecular evidence embedded in Ca^{2+} oscillations is leading to the understanding of dynamic passages of Ca^{2+} to and from the exterior of the cell, intracellular stores, cytosol, as well as Ca^{2+}exchanges between cells, diffusion, and buffering due to the binding of Ca^{2+} to proteins.

Ca^{2+} oscillations vary in amplitude, chronological profile, and spatial properties, and are likely mediated by several influx and efflux path ways adoption on different cellular procedures **[13]**. Ca^{2+} oscillations have been found to play a key role in EMF-induced cell differentiation **[51- 52]**.

2.11 Bone Remodeling

"Bone remodeling" is a highly integrable process of resorption by osteoclast cells and bone formation by osteoblast cells, which results in exactly balanced skeletal mass, with regeneration of the mineralized matrix **[53]**. (Hartig, et.al. 2000) reported that "a 16 (Hz) EMF enhances osteoblast activity while reducing osteoclast formation, shifting the balance towards osteogenesis" **[54]**. investigated "the effect of a15 Hz, 1.8mT pulsed EMF(PEMF) on cell proliferation, alkaline phosphatase (ALP) activity, gene expression, and mineralization of the ECM in hBMSCs" **[55]**.

The osteogenic differentiation yielding in a significantly changed temporal appearance of osteogenic-related genes, including a "2.7" fold 'increase inexpression of the key osteogenic regulatory gene *RUNX2/CBFA1*, matched to untreated controls. The cell exposure to PEMF significantly increased ALP expression during the early stages of osteogenes is and substantially optimized mineralization near the midpoint of osteogenesis **[56 - 57]**.

The mRNA expression of calcium channels, CACNA1C, CACNA1E, CACNA1G and CACNA1l, was activated during osteogenic differentiation. "BONE SIALOPROTEIN, BMP2, OSTEOPONTIN and OSTEONECTIN" as well as the phosphorylated extracellular signal-regulated "kinas, p-ERK" were all increased in the cells handled with MPs alone, EMF alone, and MP + EMF, comparable with the control group **[58]**. Florescence-activated cell sorting (FACS) parse of CD 73, CD 90, and CD 105 showed a decrease in these hBMSC surface indicated in the cells treated with MPs, compared with those showed to EMF. This was also seen in the cells treated with MPs, then showed to EMF, as compared with control. Cell mitochondrial activity among the four groups was parallel, showing an increase in ALP activity **[59]**.

2.12 The DXA (dual energy X-ray absorptiometry)

"The DXA" means an X ray imaging procedure primarily used to hanker the mass of one material in the presence of another, through knowledge of their exclusive X ray attenuation at different energies. Two images are scarab from the attenuation of low and high average X ray energy. DXA is a special imaging modality that is not typically available with general use X ray systems, because of the necessity for distinct beam filtering and near perfect spatial discography of the two attenuations. consecrated commercial DXA systems first became affordable in the late 1980s **[60 - 61]**.

DXA is an outeraching of an earlier imaging technique called dual energy photon absorptiometry (DPA).The DXA technique varies from DPA only in that DPA uses the attenuation of monochromatic emissions from a radioisotope "i.e. ^{153}Gd", while DXA uses polychromatic X ray spectra for every image, center at different energies **[62]**. DXA's primary commercial implementation has been to quantity BMD to assess fracture risk and to identify osteoporosis; the X ray energies used are improved for bone density assessment. The osteoporosis diagnosis" the lumbar spine, proximal hip and, sometimes, the distal forearm" are scanned. The ROIs used and the diagnostic measures are well distinct. The whole body can also be scanned to measure whole body, bone mass and soft tissue body structures **[63 - 64]**.

In image areas that comprise only soft tissue, lipid and lean tissue can be evaluated **[65]**. From which per cent lipid mass can be counted, while areas that contain bone use an assessed per cent lipid from the surrounding tissue **[66]**. The populations have been scanned and definite by sex, ethnicity and age. Diagnosis of disease is typically assumed by comparing individuals to their peer group or to a young healthy population. Currently, there are assessed to be over 50 000 whole body DXA systems in use worldwide.

DXA should be repeatable every 2 to 4 years for patients receiving ovarian hormone therapy and 1 to 2 years for patients undergoing bisphosphonate therapy. Measurements and reporting of results are standardized. Reports refer to the World Health Organization's recommended definitions. Bone mineral density (BMD) is an important element of bone strength. Its measurement is considered the best single method for evaluating future risk of osteoporotic fractures and for accentuation the diagnosis of osteoporosis **[67- 68- 61].**

A number of methods for calculating BMD have been developed. Radiographic absorptiometry has not found common use, although the modern development of developable computer analyses has redecorated interest in this technique and may lead to its re-evaluation **[69- 70]**.

2.13 DXA Bone Density

DXA is one of the most correct and exact methods for quantifying BMD and mass in vivo. The bone mineral mass, primarily comprising of hydroxyapatite, is the mineral element of bone that is left after a bone is deflated, lipids extorted and painful. The nature of the DXA system is that it produces a planar (two dimensional) image that is the combination of low and high energy attenuations. Although density is classically thought of as a mass per unit volume, DXA can only quantify the bone density as a mass per unit area, since it uses planar images and cannot measure the bone depth. The measurement of bone density using a computed tomography (CT) system, called quantitative computed tomography (QCT), can measure the true volume and volumetric bone density. The bone size varies as a function of age. DXA bone density values increase from birth to adulthood, primarily because the bones become larger. Bone size is also influenced by ethnic differences and sex. One has to be minute to compare DXA bone density values to a analogous population or results can be easily misinterpreted. Asians typically have lower DXA bone density values compared to sex and age matched Caucasians, partly due to bone size differences **[71]**.

2.14 Three Compartment Model Of Body Composition

DXA defines the structure of the body as three materials having specific X ray attenuation properties: bone mineral lipid (triglycerides, phospholipid membranes, etc.) and lipid free soft tissue. The term fat is regularly used to refer to adipose tissue. However, adipose tissue contains lipid free mass, such as water and proteins.

Fat is best defined chemically as the lipids in our body that are soluble in organic solvents and not in water, the largest category of body fat being triglycerides originate in a deposits **[72]**.

The non-lipid soft tissue mass (STM) is the sum of “body water, protein, glycerol and soft tissue mineral mass”. For each pixel in a DXA image, these three mass element are quantified. However, the distribution of the lipid, bone mineral and non-lipid soft tissue within the volume enterprise onto the image pixel is not known **[73- 74].**

The model forces all tissue types into these three element. For example, the characterizing between subcutaneous adipose tissue (SAT) and visceral adipose tissue (VAT) is lost for trunk measurements when both are enterprise in the similar pixels. The same is true for skin, visceral non-adipose tissue and muscle when all are projected in the same pixels. This restriction is true for most composition models that cannot exampled the body as a true three dimensional volume.

2.15 Measurements From DXA Scans

X-ray diffraction is a powerful non-destructive method for material characterization, by which the crystal structure, orientation, and grain size can be determined. The characterization is usually carried out with a typical X-ray wavelength that is comparable to the interatomic distance in a crystal **[75]**.The phase difference between rays reflected from subsequent planes depends on the spacing between the planes. Constructive interference occurs when the phase difference between the rays reflected from adjacent planes is an integral multiple of 2π; otherwise the rays scattered by the planes interfere destructively. Thus, scattered beams emerge only for some particular values of the angle of incidence. On the other hand, the direction of the crystal planes can be chosen in infinitely many different ways, as shown in Figure (2.13). Then the condition for constructive interference can be satisfied for several of them for a fixed incoming beam, and thus scattered beams can emerge in several directions **[75]**. In terms of the path difference Δs, constructive interference occurs when Δs is an integral multiple of the wavelength λ. According to Brag equation the scattered beams emerge only when the condition:

$$2d \sin \theta = m\lambda \qquad \text{…….. (2.7)}$$

Where d is the inter planer distance, θ is the diffraction angle is met by a family of crystal planes, where m is an integer.

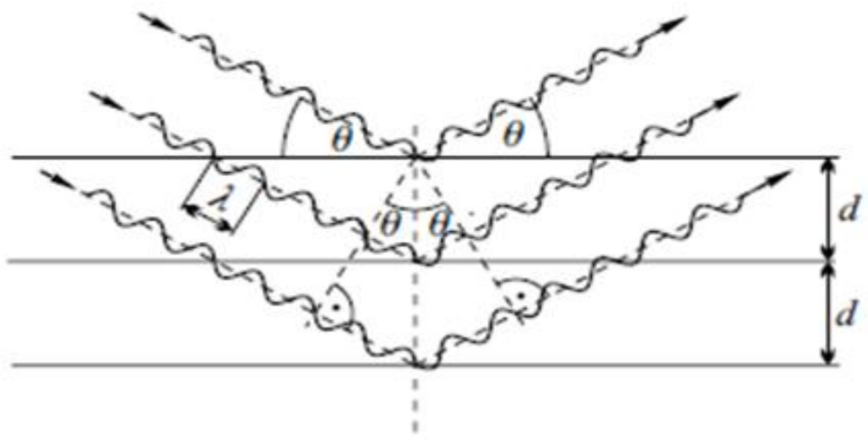


Figure 2.13 Reflection of X-ray beam of wavelength λ from a particular set of atomic planes separated by equal distances d. θ is the complement of the angle of incidence [75].

This is the Bragg condition for diffraction. The intensity of the reflected beam has sharp peaks in the corresponding directions. They are called Bragg peaks. The Bragg peak can be found by varying the angle 2θ of the detector.

There are comparatively few values reported from DXA body composition systems. They are listed here. The bone measures are affordable from all DXA scan modes while the body composition measures are only available from the whole body scan mode **[76]**.

Bone mineral content (BMC). BMC is the mineral mass component of bone in the form of hydroxyapatite "$Ca10(PO_4)_6(OH)_2$" BMC is typically measured in grams. Note that BMC does not contain the mass of any of the organic components of bone (marrow, collagen,. etc.). Thus, exactness can only be evaluated against shed bone models.

Bone area (BA). BA is the projected area of the bone onto the image plane, typically in cm^2. The exactness of BA is questionable, especially in whole body scans where bold assumptions need to be made particularly in the upper torso.

Areal bone mineral density (aBMD). ABMD is the mineral mass of bone per unit image area in (g/cm^2). Here a characterizing is made between areal density and true volume density. “Volume density” the mineral mass per unit bone volume, cannot be directly gauged by DXA but can be measured by QCT. a BMD is defined as:

$$\mathbf{aBMD = BMC / BA\ (g/cm2)} \qquad \text{……(2.8)}$$

The following measures are only from whole body scans.

Fat mass (FM). DXA FM is the public term that used in the DXA field for lipid mass, and is the sum of all lipid mass. Fat is chemically defined as triglycerides. However, DXA FM will be defined as all lipid mass, including phospholipids, organ, marrow and subcutaneous adipose. FM is measured in either (g) or (kg).

Lean soft tissue mass (LSTM). Bone free fat free STM is the sum of all soft tissue lean, essentially water, protein, soft tissue mineral and glycogen. It is measured in units of (g) or (kg).

Fat free mass (FFM). FFM is the sum of all the non-body lipid, such that:

$$\mathbf{FFM = LSTM + BMC\ (g)} \qquad \text{……. (2.9)}$$

Soft tissue mass. STM is the sum of lean soft tissue and FMs:

$$\mathbf{STM = FM + LSTM\ (g)} \qquad \text{…... (2.10)}$$

2.16 DXA Systems

In commercially affordable DXA systems, the method by which low and high energy images are gained varies according to producer. For example, the exact X ray tube voltage settings are exclusive to each producer. The need for super spatial recording between low and high energy images is critical, since this affects the *R* values. Miss-registration can lead to significant errors. For this reason, DXA is officiated using electronic detectors and digital imaging apparatus instead of film (International Atomic Energy Agency, 2011).

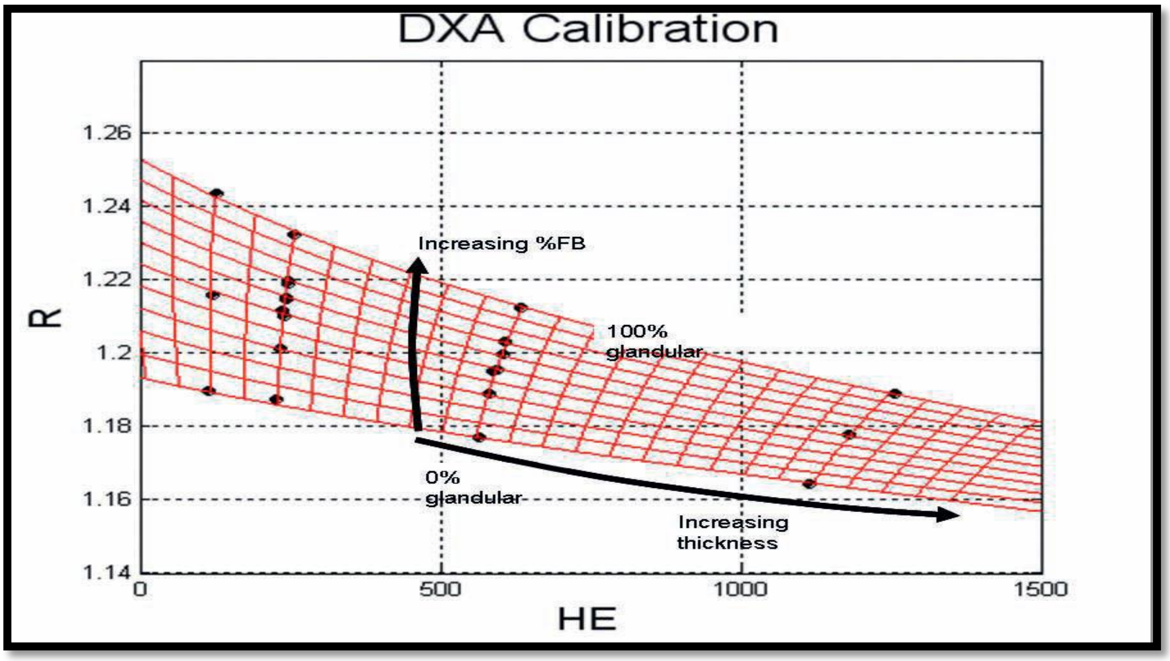


Figure 2.14 DXA calibration function defined for finding breast PCTFT for pixels of varying thickness on a Hologic Delphi. (SHEPHERD, J.A., et al., 2005).

In addition, since digital area detector typically necessitate to several seconds, if not tens of seconds to read out, scanning linear or point detectors are the most rumor for whole body and large area imaging for excellent spatial registration. DXA systems have much in rumor with other medical X ray imaging systems, with many of the same ingredient. Figure (2.6) shows atypical X ray gantry for a DXA system including the X ray tube, filtration, pre-patient aperture, inspection table or surface, pre-detector aperture and detector. Unlike plain film imaging, but similar to CT systems, the ingredient have a fixed geometry on a gantry even when scanning. The patient lies still while the gantry scans an ROI (Region of interest). The scan speed and image quality are imposed by the X ray beam geometry.

Pencil beam systems having only a single detector element have to ‘raster’ scan over an ROI, collecting one pixel at a time. Imaging time is typically “3–5” (min) for hip and spine scans, and” 20 “ (min) for whole body.

Fan beam systems use a linear detector array and collect ten or more pixels at a time. Thus, fan beam systems are much faster than pencil beam systems for equivalent imaging properties. Images of the spine or hip are typically acquired in less than 30 (s) and 3 (min) for whole body.

Cone beam geometry uses an area detector to take ‘snap-shot’ style images. Although cone beam imaging is the fastest method to take a single energy image, readout time between the images has limited their application in bone densitometry show figure (2.15).

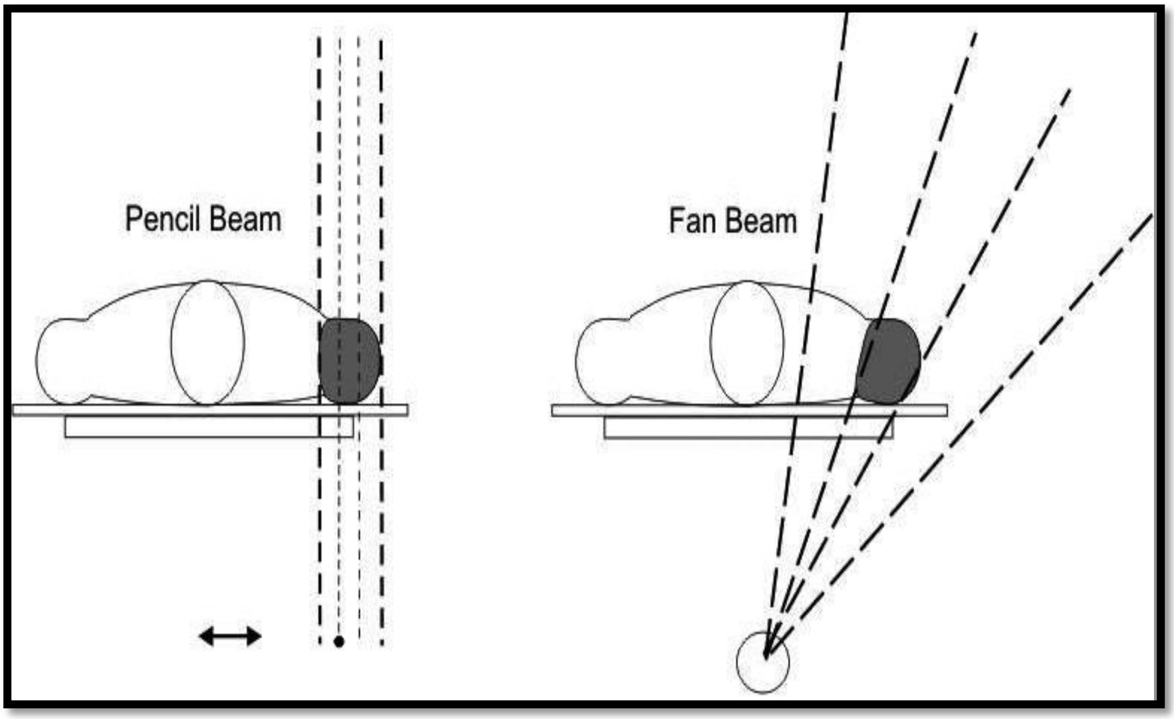


Figure 2.15 Pencil and fan beam geometries project the same ROI differently. The pencil beam image is projected perpendicular to the plane of the table, whereas the fan beam projection depends on the position of the object within the beam. The projected images, therefore, encompass different physical volumes of tissue when projected back to the X ray source (courtesy of J. Shepherd, UCSF).

If a patient takes a breath between low and high energy images, grievous artifacts result and void on the scan. For “pencil and fan beam systems” the low and high images of the pixel (pencil beam) or row (fan beam) are collected in milliseconds before the gantry shifts to the next row. Thus, breathing is allowed during the exposure with minimal miss-registration. “Unlike pencil beam systems fan” and cone beam images do contain X ray scatter; however, scatter disallowing is very high for fan beam compare to cone beam systems. It is important to note that fan, pencil and cone beam systems project the three dimensional human body onto the two dimensional image in different ways **[77- 78]**.

“The pencil beam image” is projected perpendicular to the level of the table, the fan beam image may be projected under a sure angle in the direction parallel to the fan width, and the cone beam image may be projected under an angle in both image directions **[79]**.

Thus, even if identical ROIs are outlined on the resulting images, these ROIs are projections of different physical volumes of caring. This difference between pencil, fan and cone beam ROIs is one of definition. DXA ROI definitions are arbitrary; both projections and measurements are evenly correct **[80- 81]**.

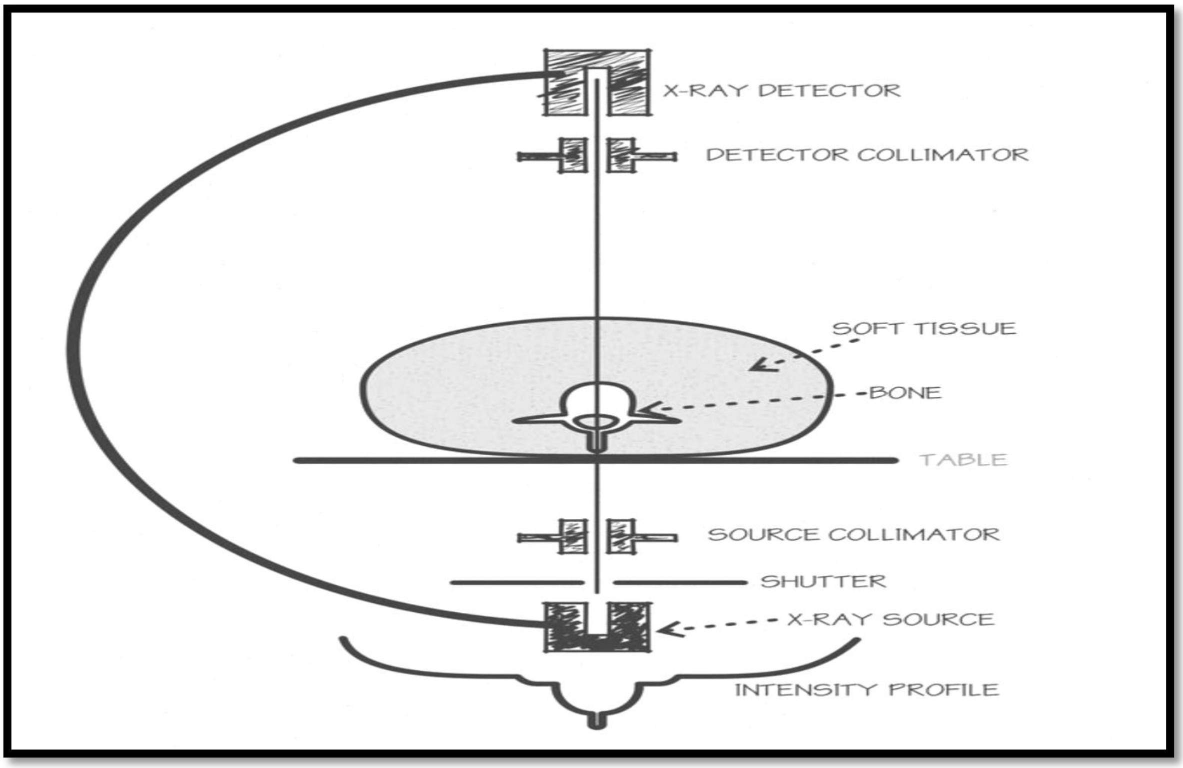


Figure 2.16 Schematic diagram explain the components of a DXA system (courtesy of J. Shepherd, UCSF*).*

2.17 Reference Data And Associated Values

Reference data are used to compare the single to a demographic. The average values acquired from a DXA scan, such as aBMD, BMC, PCTFM, etc., differ between groups by age, sex and ethnicity. Therefore, there have been many studies to designated a variety of ethnicities for both sexes.

In Figure (2.16) shows total hip aBMD versus age for Hispanic, black and non-Hispanic Caucasians for both males and females living in the United States of America **[82]**.Care must be used.to compare individuals to the reference curves that best match their age, sex and ethnicity if looking for normality. For example, if the aBMD of a black male is compared to the Caucasian male reference curve, the black male would appear to have unusually high aBMD for his age, when in fact the aBMD may be normal when compared to other black men.

Much of these differences can be attributed to bone size. Reference data have two practical purposes for DXA systems determining fracture risk (*T*-scores) and determining how an individual compares to their peers (*Z*-scores). When determining fracture risk with values such as the *T*-score, it may be appropriate to compare every one, men and women of different ethnicities, to the same reference curve after adjustments for bone size, since bone strength is a material property.

Since more is known regarding how BMD relates to fracture risk in Caucasian women than in men or other ethnicities, it is recommended that Caucasian women be used to calculate *T*-scores and how the *T*-score relates to fracture risk. Who recommends calculating all adult *T*-scores from the Caucasian women's reference values from the NHANES III study. It is important to note that reference data are acquired using a manufacturer specific positioning protocol, analysis procedures and software version. If the clinical patient is positioned differently than described by the manufacturer's manual, analyses with different ROIs or software version, significant bias can occur. The substantial differences have been reported for the total femur aBMD at different angles of rotation **[83]**.

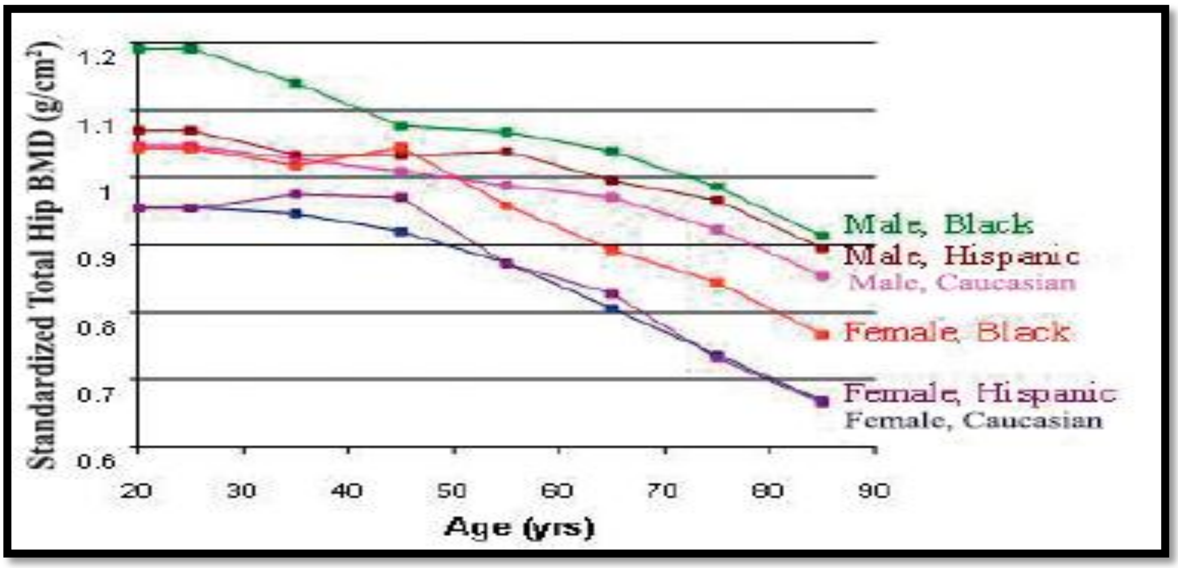


Figure 2.17 Hip reference data from the NHANES III Study. aBMD is shown in standardized sBMD units(plot courtesy of J. Shepherd, UCSF).

2.18 Use of reference data for generating *T* and *Z* scores

The *T*-score is the primary diagnostic value used for osteoporosis as in the elderly, post-menopausal women and men over 50 years, the *T*-score is inversely related to fracture risk. A *T* score is the difference between the patient's aBMD and a young reference aBMD in units of the population SD. Since the report of the WHO study group published in 1994 **[84]**. The ISCD has been one of several organizations developing guide lines for scan interpretation based on the use of *T*-scores and *Z*-scores **[85].** The *T* score was first introduced in the late1980s and I defined as:

$$\mathbf{T-score} = \frac{\textbf{aBMD patient} - \boldsymbol{aBMD}\ \textbf{Young Adult Mean}}{\textbf{SD Young Adult Mean}} \qquad \textbf{……(2.9)}$$

SD is the standard deviation of the population of young adults. aBMD can also be expressed as a *Z*-score, the difference between the patient's aBMD and an age and typically ethnicity matched reference aBMD and SDs:

$$\mathbf{Z-score} = \frac{\textbf{aBMD patient} - \boldsymbol{aBMD}\ \textbf{age,ethnicity matched Adult Mean}}{\textbf{SD age,ethnicity matched Adult Mean}} \qquad \textbf{…..(2.10)}$$

The *T*-score is used to diagnose osteoporosis in older adults while the *Z*-score is used to diagnose low bone mass in young adults and children. A frequent presumption is that the *T* and *Z* score should be very similar or identical for younger individuals. However, current guide lines are to derive the *T*-score from one particular reference population. The original who criteria are stated in Table (2.2).

Table 2.2 Criteria for Diagnosing Osteoporosis from *T*-Scores **[85]**. It should be noted that this criterion is exclusively application for post-menopausal women and men over 50, and not for young adults or children.

Status	Criteria
Normal	aBMD is within 1SD of a young normal adult (T-score at – 1.0 and above)
Low bone mass (osteopenia)	aBMD is between 1 and 2.5 SD below that of a young normal adult (T-score between -1 and -2.5)
Osteoporosis	aBMD is 2.5 SD or more below that of a young normal adult (T-score at or below -2.5)
Severe (astablished) (Osteoporosis)	T-score at or below -2.5 and one or more fractures

Table 2.3 *T*-Score reference values for femoral neck aBMD (gm/cm^2) nhanes III, Phase 1, 1988–1991 **[82]**. It should be noted that these aBMD values are in Hologic calibration units.

Sex(race/ethnicity)	Age rang	N	aBMD mean (g/cm^2)	SD (g/cm^2)
Female (non-Hispanic/Caucasian)	20-29	194	0.849	0.109
Male (non-Hispanic/Caucasian	20-29	207	0.930	0.138

WHO recommends that the *T* scores to diagnose osteoporosis in men and women, and to define prevalence of disease, should be derived exclusively from the femoral neck aBMD values for Caucasian females, 20-29 years old, found in the NHANES III database **[84]**. These values were implemented on all the major bone densitometer brands after conversion to their respective calibrations.

The values given in WHO in 1994. Are for Hologic systems (Table 2.3) There is still debates to whether men should be compared to the female reference data or to a male reference data set. For example, the ISCD states in their position document that osteoporosis can be diagnosed using a *T* score less than or equal to –2.5 from either the spine, total hip, femoral neck or one-third radius, and that men should be compared to men and women to women. However, the who criteria are not directly applicable to DXA bone density measures not acquired at the spine, hip or one-third radius.

The who criteria should not be applied to other bone density measures, including QCT of the spine or hip, peripheral densitometry systems using ultrasound, DXA or other technologies that scan the fingers, metacarpals or heels.

Chapter Three

Materials and Methods

3.1 Administrative Arrangement

Before the collection of data and bring the animal samples , formal administrative approval was obtained from the following:

1- Ethical approval. (appendix 1).

2-Ministry of Health, department of technical things , department of pharmacy, checking anesthesia model (appendix 2).

3.2 Design of the study

A cross-sectional study done from the 1st November 2017 – 1st may 2018, in order to achieve the required objective of the present study.

3.3 Objective of the study

Estimate the impact of electromagnetic field and also simultaneous action of those fields, on the intensity of bone turnover process in rats, by means of analysis bone density, throughout investigating the beneficial effects of magnetized Green Tea, water, and pellet for animals.

3.4 Setting of the study

The investigations of current study were carried out in Diyala University - Collage of Medicine .

3.5 Reliability of Study

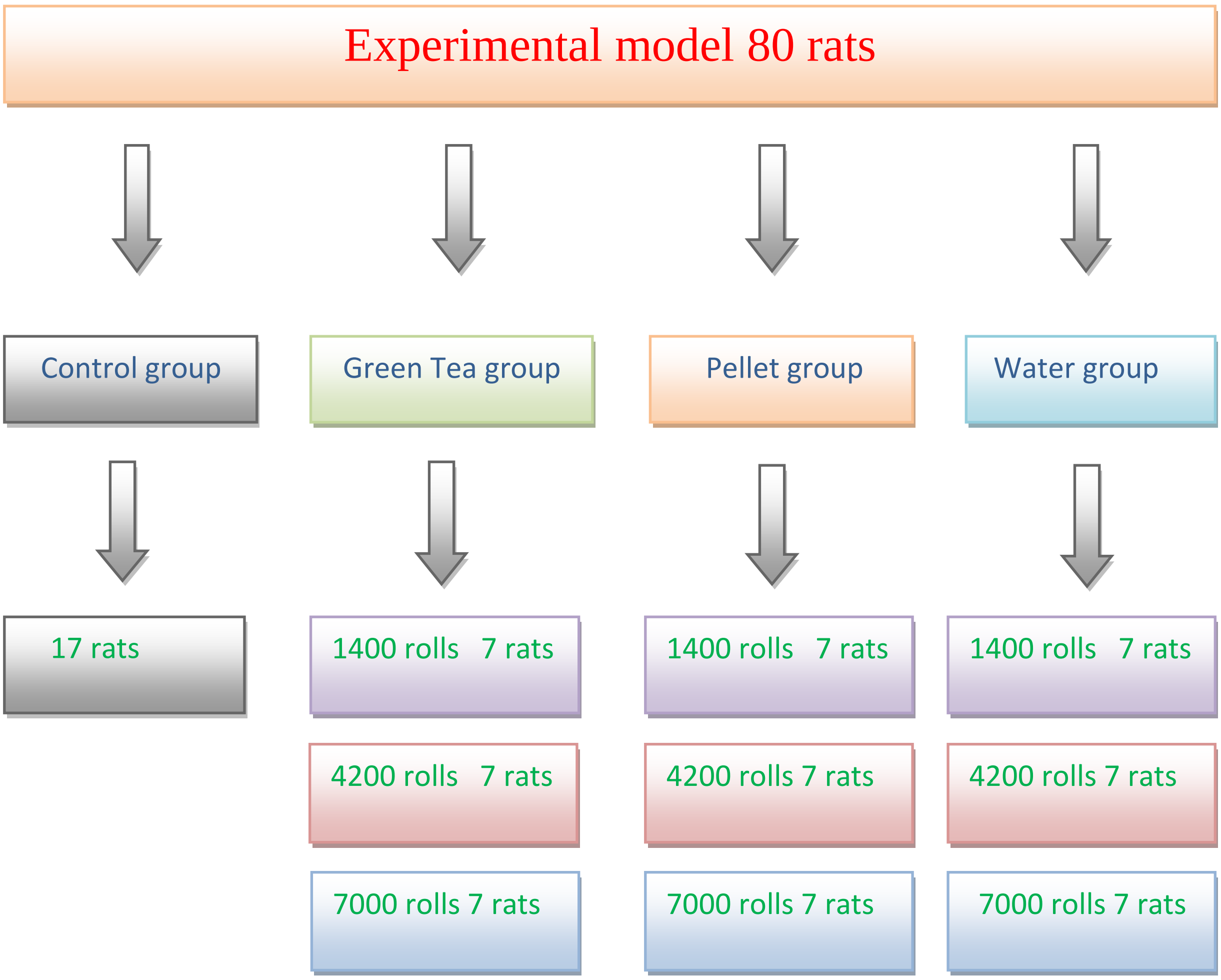
Reliability refers to the consistency of the scores obtained. Which is the consistent scores for each individual from one administration of an instrument to another and from one item to another. Reliability is a measure of how stable, dependable, trustworthy and consistent (the test is in measuring the same thing each time). Reliability, is numbers of animals that used in the studies that based on a statistical power calculation for sample size, using the method of **[86]**. All data were tested for normality using the post-hoc Tukey-Kramer test for pair-wise multiple comparisons treatment.

3.6 Data collection

The data collection have been conducted during a period of 21 days in January 2018. The animal procurement from Ministry of Health , Quality Measurement section , laboratory animal house.

3.6.1 Sample Collection

The animal procurement from Ministry of Health, Quality Measurement section and laboratory animal house. The rats were divided into 4 equal groups subjected to specific-term exposure to electromagnetic fields with different physical parameters and different procedure of exposure as shows Scheme (3.1).



Scheme (3.1) shows distribution of animal samples of experiment.

3.6.2 Equipment and supplies

The following equipment and supplies were used for Biochemical analysis of the study:

3.6.2.1 Magnetized System

The system of magnetization , an important part of current thesis in which create magnetic field makes the materials magnetize, is collected, designed, and manufactured manually by the researcher in order to meet the requirements in demand, materials, and specific ratios of the reasherch which approved by supervisors of current study as shown in figure (3.1). shown the Table (3.1):

Table (3.1) show the components and Specification of the Magnetized System

	Components	Specification
1	Iron tube open from two ends	length 45 cm and inner diameter 1.5 cm
2	Iron wire	diameter 0.3 mm
3	Electric source	220 V
4	Power supply	regulated the voltage supply
5	Gage	measure the current and voltage
6	Magnetometer	measurement the flux meter (change field)
7	Wood box	(50 * 15) cm
8	Water faucet	Plastic

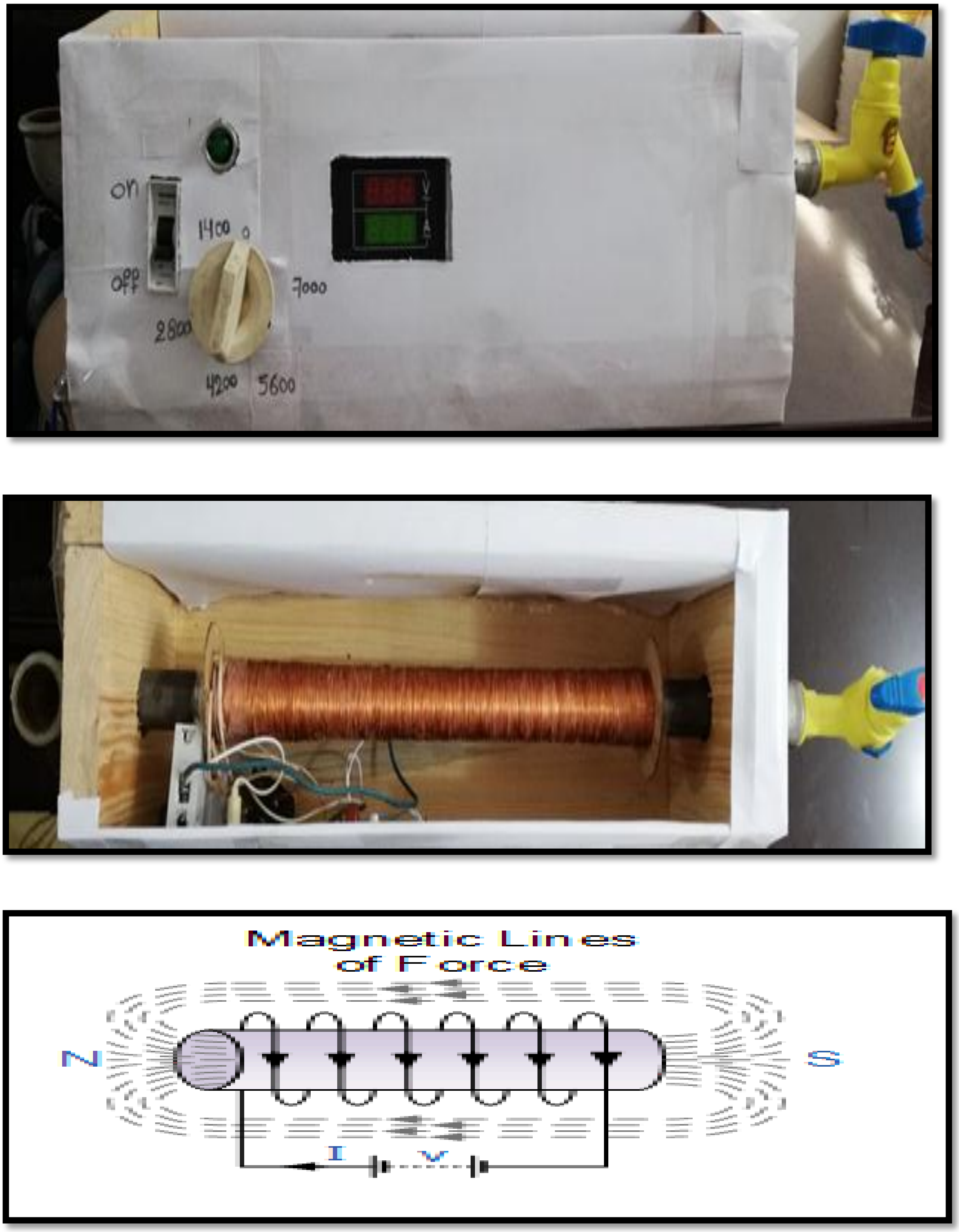


Figure 3.1 system of magnetization device for required magnetic field.

The iron tube is fixed horizontally inside the wooden box and wrapped up around it iron wire of 0.3 mm diameter about 7000 roll dividing these rolls into 5 taps according to data reviled in Table (3.2).

Table 3.2 NO. of rolls for each Tap around iron tube and the flux of each tap.

No. of Taps	No. of Rolls	The Flux
Tap1	1400 rolls	1.5 mT
Tap 2	2800 rolls	1.9 mT
Tap 3	4200 rolls	0.9 mT
Tap4	5600 rolls	0.5 mT
Tap 5	7000 rolls	0.3 mT

The length of the wire has been measured in each step or tap by using the following special equation :-

The length of wire in single tap= $2\pi R * the\ number\ of\ rolls\ in\ the\ same\ tap$**….(3.1)**

Number of rolls controlled by the channel installed on the wooden box and the device is connected to the power supply. To install the voltage difference using 220 volts in my experience and the whole system is connected to the point of electricity chamber as the system current is direct current DC.

3.6.2.2 Digital Gauss Meter

Table (3.3) show the Technical Specifications

	Feature	Details
1	measuring range	0 ~ 200mT ~ 2000 mT
2	Accuracy	0 ~ 100mT 1%, 100mT more than 2% (uniform magnetic field measurement)
3	Resolution	-DC × 1: 0.00 ~ 200.00mT 0.01mT -DC × 10: 0.0 ~ 2000.0mT 0.1mT - AC × 1: 0.00 ~ 200.00mT 0.01mT -AC × 10: 0.0 ~ 2000.0mT 0.1mT

Figure 3.2 Digital Gauss Meter for Magnetic Flux Measurement

3.6.2.3 Chemicals and Reagents

1- Green tea, dried leaves of the Camellia sinensis species of the Theaceae family **[87]**.

2- Pellets (Altromin 1324, Altromin GmbH, Lage, Iraq).

3- water (Hydrogen and Oxygen atoms).

3.6.2.4 Animals and protocols

The animal procured from Ministry of Health, Quality Measurement section, laboratory animal house. Total of 80 males and females adult Wister rats (Rathus Norvegius) figure (3.3) and aged about 6-8 weeks were used in this study. The animals were housed in individual plastic cages measured 40 × 25 × 25 (cm) with wood chip bedding in plastic cages. The animals were keptat 25°C, under a 12-12 light /dark cycle and free access to commercial rat pellets and tap water (Altromin 1324, Altromin GmbH, Lage, Iraq). All nutrients that are necessary for rapid growth in growing male rats and reproduction in adult female rats based on AIN-93G and AIN-93M, respectively **[88]**.

Rats were monitored daily for general health and changes in appearance or behavior throughout the study. The rats were cared and maintained in compliance with the Guide for the Care and Use of Laboratory Animals **[89]**. Ethical consent for the study protocols of rats were obtained from the Diyala University Ethics Committee.

Figure 3.3 show Wister rats (Rathus Norvegius)

Pre-operatively, and according to Institutional Animal Care, each rat (about 250 gm weighting) has anaesthetized with injection an aesthetic (Ketamine Hydride USP: ketamine 50 mg/ml for i.m./i.v. injection ; Batch NO. :70407 ; Germany), and a dose of general analgesia (0.01 mg/kg) was given intramuscularly. Once the rats reached the required depth of anesthesia , left-sided femur (arm and leg) of each selected rat (selection due to highly response of magnetized nutrition's; water, tea and pellet separately) fractured by researcher under supervision to ensure rats stability during procedure for testing BMD and BMC values affected under specific conditions with magnetized nutrition.

3.7 Magnetic Exposure

The water is placed in the iron pipe from the open side. Before that, making sure to close the water tap connected to the other side and open the power point to make sure that the voltage difference is set to the required value by the voltage regulator as well as fix the required number of rolls and open the device to measure the magnetization period Timing.

The time of the experiment was 60 seconds (according to my pilot study: we used 10 rats, one rat for each group "Water in (1400, 4200 and 7000) rolls and Green tea in (1400, 4200 and 7000) rolls and Pellet in (1400, 4200 and 7000) rolls and control" and then the water opened faucet to collect the water in the drip and measure the magnetic flux by gauss meter.

Magnetism happens by directing all the water molecules towards the field that is placed on the iron tube. The water is inside. The electromagnetic field is surrounded by all the water molecules. The electromagnetic field effect is stronger than magnetization by magnets and the magnetization is weaker because it only moves the molecules that located on the boundary of the field as shown in Figure (3.4).

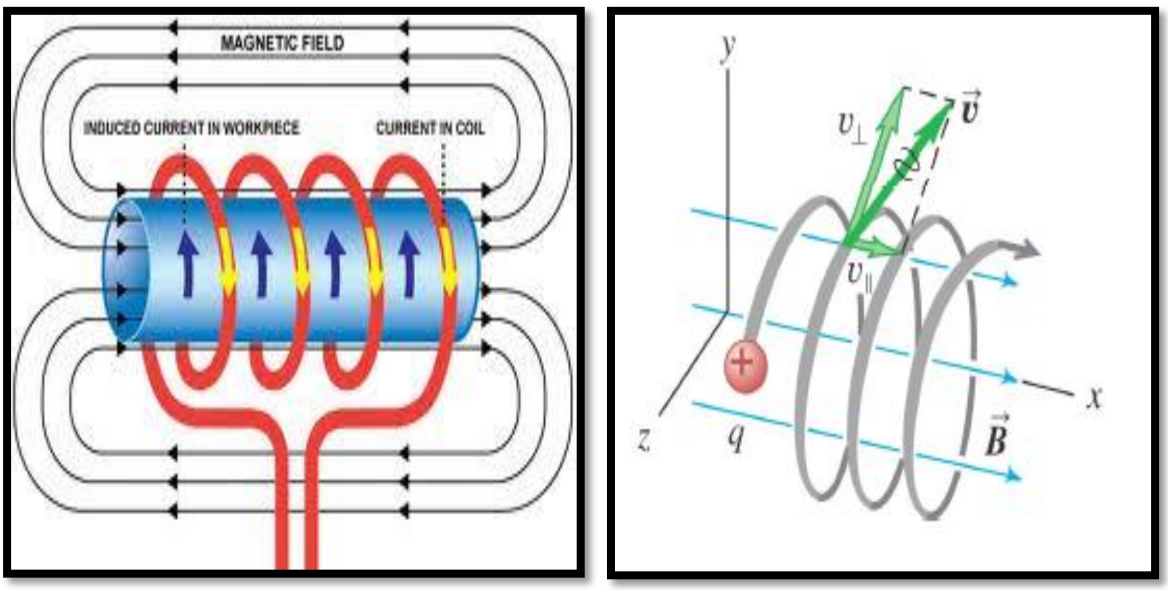


Figure 3.4 the effect of Electromagnetic field on the materials passing within the tube

3.8 Preparation of Green Tea, Tap water and pellets

Tap water was used to prepare Green Tea and water extracts. Tap water was used in the study to optain normally minerals pre-excist in water throughout the experimental period. The Green Tea were freshly prepared by infusing the Green Tea leaves in water.

mixing Pellet with the magnetized water for 30 (min). The Green Tea solutions were filtered with sterile filter to produce a clear solution and allowed to cool at room temperature.

Green Tea water extracts and water were supplied in clean polyethylene water bottles, as the only source of drinking fluid during the study duration while the pellet disposable plates . Green Tea , Tap water and pellets were served fresh once every day during the feed intake measurement.

Polyethylene water bottles were cleaned weekly ;whereas water bottles for tea drinks were cleaned thoroughly once every day during the fluid intake measurement to prevent spoilage from bacteria or traces of Green Tea residues.

3.9 Evaluation of Bone Densitometry By Using DXA

Results were generally scored by two measures, T-score and Z-score. Scores indicate the amount one's bone mineral density varies from the mean. Negative scores indicate lower bone density, and positive scores indicate higher in addition to Pelvis BMD and Pelvis BMC score.

Figure 3.5 DXA X-ray imaging technique measures Bone Densitometry

3.10 Diagnose Fractured bones through X-ray Unit

Standard x-rays cannot be used in place of bone density tests. X-rays are not able to detect osteoporosis until the disease is well advanced. However, due to resent study X-ray unit (Model: DL- 201 ; Input: 220v 50/60Hz 1kVA; Output: 70kVP 8mA 4Sec) with radiation does age 54, 60, and 52 and readymade periodical film has been additionally used with a DXA in order to detect and diagnose fractured bones due to fractures healing process, assessing the period of fractures healing for each rat and reported recurrent complications of misplaced fracture as shown in Figure (3.11). Moreover, it appears that commination in different degrees has been particularly difficult to control for during analysis X ray images deliver a highly standardized range of fractures created with no bending in the lateral plane but marked bending in the fracture .

Figure 3.6 X ray unit with imaging technique measures Bone Fracture.

3.11 Limitation of the study

1. This study is the first to estimate the occurrence of magnetized nutrition's (water, tea and pellet) and their implication in a rat femur fracture model.

2- There are few research were carried recently on this topic.

3.12 Protective measures

Protective measures and personal hygiene to find if protective equipment, hygiene and knowledge of pollution risks have an impact on magnetic exposure in this study.

3.13 Statistical analysis

Results are presented as means with their standard error of the mean (mean ±SEM). Statistical analyses on the data were carried out using the available statistical package of SPSS-02 (Statistical Package for Social Sciences version 2). All data were tested for normality using the PROC UNIVARIATE, a procedure used mainly for examining the distribution of data. Homogeneity of group variances was estimated using Levene’s test.

The vayiaty of group means were compared using one-way analysis of variance (ANOVA), followed by post-hoc Tukey's test for pair-wise multiple comparisons of the group means. The Welch's variance-weighted ANOVA was used in place of the simple one-way ANOVA when the assumption of homogeneity of variances was not met and groups were unequal in size, which was followed by post hoc Tukey test for pair-wise multiple comparisons.

The ANOVA analyses were conducted using procedure of SPSS that analyses data within the frame work of general linear models. The Tukey post hoc test is generally the preferred test for conducting post hoc tests on a one-way ANOVA. All measurements were carried out in triplicate across independent experiments, unless otherwise stated. A difference was considered to be statistically significant when $p \leq 0.05$.

Chapter Four
Results and discussion

4.1 Introduction

The present results utilized from the experimental part of the study includes, impact of electromagnetic field experiment, and simultaneous action of intensity of bone turnover in rats, compares the efficiencies in each case as well as the spectral measurements. The gain achieved from the magnetization system has been analyzed in accordance with effectiveness of magnetized materials all of Green Tea, water, and pellet.

The collected information in this section was further put to a statistical analysis. The results obtained are presented here in this chapter based on SPSS Statistics generates tables in one-way ANOVA analysis and Tukey post hoc test.

In current, study rats have treated daily for 21 days with magnetic water, green tea, pellet. A significant increase in concentration of high density of bone (BMD, BMC, T-score and Z-score) and given magnetized water with intensity of 1400, 4200, 7000 every day was displayed. However. The rats were sacrificed and the histological change on bone density after femur fracture. Bone mineral density has be measured only to assist in making a clinical management choice. DXA is the best method of measuring bone density and, thus, the best available indicator of fracture risk. Plain radiographs of supplement to DXA when there is a specific reason for the use.

The sample for the study was divided into four categories according to The ANOVA statistical evaluation of the mean values of group (control, water, tea and pellet) number of rolls (1400, 4200 and 7000) as shown in Tables and figures bellow:

4.2 Pelvis (BMD, BMC, T-score and Z-score)

The distribution of Pelvis (BMD, BMC, T-score and Z-score) among study sample (water, Tea and pellet) according to Mean, as appears below the Control Group (BMD = 0.04, BMC= 0.50, T-score = 4.81, Z-score = 5.00), the highest mean value in BMD exists Pellet (mean =0.22, SE ±0.017) the less value in Water (mean = 0.19, SE ±0.005). According to BMC the highest mean value exists in Pellet (mean= 27.16, SE ±1.688) less value in Water (mean=17.57, SE ±0.655). While in T-score the highest mean value exists in Tea (mean= 17.04, SE ±0.667) less value in Pellet (mean = 14.57, SE ±0.638). While in Z-score the highest mean value exists in Water (mean= 19.09, SE ±0.534) less value in Tea (mean = 17.90, SE ±0.597). According to the ANOVA Analysis the highest statistically significant difference appears in pelvis – BMC pelvis – T-score $p \leq 0.05$. [Table 4.1] [appendix 3].

Table 4.1 The distribution of pelvis (BMD, BMC, T-score and Z-score) among study sample (water, Tea, pellet and control) according to Mean and Str. Error of Mean.

Nutrition	Pelvis BMD	Pelvis BMC	Pelvis T-score	Pelvis Z-score
Water	0.19 ± 0.005 b	17.57 ±0.655 c	15.28 ±0.594 b	19.09±0.534 a
Tea	0.21±0.005ab	22.49 ±2.329 b	17.04 ±0.667 a	17.90 ±0.597 a
Pellet	0.22 ± 0.017 a	27.16 ±1.688 a	14.57 ±0.638 b	18.28 ±0.802 a
Control	0.04 ± 0.001 c	0.50 ±0.021 d	4.81 ±0.208 c	5.00 ±0.204 b
Total	0.16±0.007	16.93 ±1.173	12.92 ±0.526	15.06 ±0.534
Sig.	0.019	0.000	0.002	0.092

•=The mean difference is significant at the 0.05 level according Tukey test.

•= test treat between Nutrition groups.

The distribution of Pelvis (BMD, BMC, T-score and Z-score) among magnetic fields (1400, 4200, 7000 rolls and control) according to Mean, as appears below the control group (BMD = 0.04, BMC= 0.50, T-score = 4.81, Z-score = 5.00), the highest mean value in BMD exists 4200 roll (mean =0.22, SE ±0.016) the less value in 7000 roll (mean = 0.18, SE ±0.004). According to BMC the highest mean value exists in 4200 roll (mean= 26.67, SE ±2.162) less value in 7000 roll (mean=15.48, SE ±1.255). While in T-score the highest mean value exists in 1400 roll (mean= 16.28, SE ±0.897) less value in 7000 roll (mean = 15.00, SE ±0.475). While in Z-score the highest mean value exists in 1400 roll (mean= 19.85, SE ±0.566) less value in 7000 roll (mean=16.42, SE ±0.475). Magnetic field group highest statistically significant difference appears in pelvis – BMD, pelvis – BMC, and pelvis – Z-score $p \leq 0.05$. **[**Table 4.2] [appendix 4].

Table 4.2 The distribution of pelvis (BMD, BMC, T-score and Z-score) among magnetic fields (1400, 4200, 7000 rolls and control) according to Mean and Str. Error of Mean.

Magnetic field	Pelvis BMD	Pelvis BMC	Pelvis T-score	Pelvis Z-score
1400 roll	0.21±0.007a	25.08±1.045 b	16.28±0.897 a	19.85±0.566 a
4200 roll	0.22±0.016 a	26.67±2.162 a	15.61±0.558 a	19.00±0.676 a
7000 roll	0.18±0.004 b	15.48±1.255 c	15.00±0.457a	16.42±0.475 b
Control	0.04±0.001 c	0.50±0.021 d	4.81±0.208 b	5.00±0.204 c
Total	0.16±0.007	16.93±1.120	12.92±0.53	15.06±0.480
Sig.	0.000	0.000	0.178	0.000

•=The mean difference is significant at the 0.05 level according Tukey test.

•= test treat between magnetic field groups.

The treatment of Pelvis (BMD, BMC, T-score and Z-score) Multiplying with (nutrition × magnetic field) according to Mean, as appears below the Control Group (BMD =0.04, BMC=0.50, T-score =4.81, Z-score =5.00), the highest mean value in BMD exists in pellet T2 (mean =0.30, SE ±0.031) the less value in pellet T3 (mean =0.16, SE ±0.005). According to BMC the highest mean value exists in pellet T2 (mean=37.36, SE ±0.887) less value in Tea T3(mean=7.97, SE ±0.467). While in T-score the highest mean value exists in

Tea T1 (mean=19.71, SE ±0.865) less value in pellet T1 (mean=11.71,SE ±0.521). While in Z-score the highest mean value exists in pellet T2 (mean=22.57, SE ±0.571) less value in pellet T3 (mean=15.28, SE ±0.892). Nutrition × Magnetic field group the high accuracy statistically significant difference appears $p \leq 0.05$. [Table 4.3] [appendix 5].

Table 4.3 The distribution of Pelvis (BMD, BMC, T-score and Z-score and control) treatment multiplying with (nutrition × magnetic field and control) Mean and Str. Error of Mean.

	Pelvis BMD	Pelvis BMC	Pelvis T-score	Pelvis Z-score
Water 1400	0.21±0.008c	20.61±0.609 e	17.42±1.172ab	21.42±0.649 a
Water 4200	0.17±0.007 c	14.20±0.487 b	13.42±0.571 cd	17.85±0.828 b
Water 7000	0.18±0.009 c	17.90±0.489 d	15.00±0.690bcd	18.00±0.617 b
Tea 1400	0.23±0.007 b	31.07±1.087 f	19.71±0.865 a	21.14±0.508a
Tea 4200	0.20±0.007bc	28.43±0.507 c	16.14±0.91bc	16.57±0.480 b
Tea 7000	0.19±0.003bc	7.97±0.467 a	15.28±1.016bc	16.00±0.654b
Pellet 1400	0.19±0.014bc	23.55±0.615 g	11.71±0.521 d	17.00±0.690 b
Pellet 4200	0.30±0.031 a	37.36±0.887 e	17.28±0.808ab	22.57±0.571 a
Pellet 7000	0.16±0.005 c	20.58±0.777 e	14.71±0.746bcd	15.28±0.892 b
Control	0.04±0.001d	0.50±0.021 I	4.81±0.208 e	5.00±0.204 c
Total	0.17±0.009	17.97±1.320	13.44±0.580	15.70±0.682
Sig	0.000	0.000	0.000	0.000

•=The mean difference is significant at the 0.05 level according Tukey test.

•=Test treat between Nutrition and Magnetic field groups.

Table 4.4 The Correlation coefficients variables for pelvis (BMD, BMC, T-score and Z-score).

	Pelvis BMD	Pelvis BMC	pelvis T-Score	pelvis Z-Score
Pelvis-BMD	1	835**	.807*	.852**
Pelvis-BMC		1	.766**	.819**
pelvis T-Score			1	.857**
pelvis Z-Score				1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

4.3 Left leg (BMD, BMC, T-score and Z-score)

The distribution of Left leg (BMD, BMC, T-score and Z-score) among study sample (water, Tea and pellet) according to Mean, as appears below the Control Group (BMD = 0.04, BMC= 0.50, T-score = 4.81, Z-score = 5.00), the highest mean value in BMD exists Tea (mean =0.20, SE ±0.006) the less value in Pellet (mean = 0.17, SE ±0.004). According to BMC the highest mean value exists in Water (mean= 68.28, SE±2.444) less value in Tea (mean=28.54, SE ±3.959). While in T-score the highest mean value exists in Tea (mean= 20.76, SE ±0.635) less value in Pellet (mean = 16.95,SE ±0.368). While in Z-score the highest mean value exists in Water (mean= 20.19, SE±0.702) less value in Pellet (mean = 20.66, SE ±0.744). According to the ANOVA Analysis, in nutrition group no statistically significant difference appears only in Left Leg – Z-score $p \leq 0.05$. [Table 4.5] [appendix 6].

Table 4.5 The distribution of Left leg (BMD,BMC, T-score and Z-score) among study sample (water, Tea, pellet and control) according to Mean and Str. Error of Mean.

Nutrition	Left leg BMD	Left leg BMC	Left leg T-score	Left leg Z-score
Water	0.18±0.004 b	68.28±2.444 a	18.76±0.542 b	22.19±0.702 a
Tea	0.20±0.006 a	28.54±3.959 c	20.76±0.635 a	20.95±0.603ab
Pellet	0.17±0.004 b	37.04±5.546 b	16.95±0.368 c	20.66±0.744 b
Control	0.04±0.001 c	0.50±0.021 d	4.81±0.208 d	5.00±0.204 c
Total	0.14±0.015	33.59±2.992	15.32±0.438	17.2±0.563
Sig.	0.000	0.000	0.002	0.041

•=The mean difference is significant at the 0.05 level according Tukey test.

•=Test treat between Nutrition groups.

The distribution of Left leg (BMD, BMC, T-score and Z-score) among magnetic fields (1400, 4200 and 7000 rolls) according to Mean, as appears below the Control Group (BMD = 0.04, BMC= 0.50, T-score = 4.81, Z-score = 5.00), the highest mean value in BMD exists 4200 roll (mean =0.20, SE ±0.005), the less value in 4200 roll (mean = 0.18, SE ±0.004). According to BMC the highest mean value exists in 4200 roll (mean= 67.84, SE ±2.450) less value in 1400 roll (mean=27.45, SE ±4.058). While in T-score the highest mean value exists in 1400 roll (mean= 20.47, SE ±0.732) less value in 7000 roll (mean = 17.71, SE ±0.606). While in Z-score the highest mean value exists in 1400 roll (mean= 23.09, SE ±0.572) less value in 7000 roll (mean = 19.42, SE ±0.611). Magnetic field group appears a high accuracy significant difference when $p \leq 0.05$. [Table 4.6] [appendix 7].

Table 4.6 The distribution of Left leg (BMD, BMC, T-score and Z-score) among magnetic fields (1400, 4200, 7000 rolls and control) according to Mean and Str. Error of Mean.

Magnetic field	Left leg BMD	Left leg BMC	Left leg T-score	Left leg Z-score
1400 roll	0.20±0.005 a	27.45±4.058 c	20.47±0.732 a	23.09±0.572 a
4200 roll	0.18±0.004 b	67.84±2.350 a	18.28±0.285 b	21.28±0.662 b
7000 roll	0.18±0.006 b	38.567±5.540 b	17.71±0.606 b	19.42±0.611 c
Control	0.04±0.001 c	0.50±0.021 d	4.81±0.208 c	5.00±0.204 d
Total	0.15±0.004	33.58±2.992	22.24±0.457	17.19±0.512
Sig	0.001	0.000	0.000	0.000

•=The mean difference is significant at the 0.05 level according Tukey test.

•=Test treat between Magnetic field groups.

The treatment of Left leg (BMD, BMC, T-score and Z-score) Multiplying with (nutrition × magnetic field) according to Mean, as appears below the control group (BMD = 0.04, BMC= 0.50, T-score = 4.81, Z-score = 5.00), the highest mean value in BMD exists in Tea T1 (mean =0.23, SE ±0.009) the less value in pellet T3 (mean = 0.16, SE ±0.005). According to BMC the highest mean value exists in water T2(mean= 78.38, SE ±0.136) less value in pellet T1(mean=14.78, SE ±0.141) While in T-score the highest mean value exists in Tea T1(mean= 23.57, SE ±0.685) less value in pellet T3 (mean = 15.71, SE ±0.359). While in Z-score the highest mean value exists in water T1 (mean= 25.28, SE ±0.944) less value in pellet T3 (mean = 17.00, SE ±0.487). nutrition × Magnetic field group a high accuracy significant difference appears p≤ 0.05. [Table 4.7] [appendix 8].

Table 4.7 The distribution of Left leg (BMD, BMC, T-score and Z-score) treatment multiplying with (nutrition × magnetic field and control) according to Mean and Str. Error of Mean.

	Left leg BMD	Left leg BMC	Left leg T-score	Left leg Z-score
Water 1400	0.19±0.006bcd	53.11±0.224 d	21.28±0.521 b	25.28±0.944 a
Water 4200	0.19±0.005bc	78.38±0.136 a	18.85±0.508 c	22.14±0.594bc
Water 7000	0.17±0.004 de	73.36±0.489 b	16.14±0.459 e	19.14±0.737 cd
Tea 1400	0.23±0.009 a	31.07±0.179 g	23.57±0.685 a	22.57±0.685ab
Tea 4200	0.17±0.005cde	53.51±0.194 d	17.42±0.480cde	18.14±0.670 d
Tea 7000	0.21±0.006ab	17.64±0.175 f	21.28±0.359 b	22.14±0.857bc
Pellet 1400	0.18±0.005cde	14.78±0.141 g	16.57±0.611 de	21.42±0.782bc
Pellet 4200	0.18±0.008cde	71.63±0.174 c	18.57±0.368 cd	23.57±0.972ab
Pellet 7000	0.16±0.005e	24.70±0.387 e	15.71±0.359 e	17.00±0.487 d
Control	0.04±0.001 f	0.50±0.021 h	4.81±0.208 f	5.00±0.204 e
Total	0.16±0.007	35.68±3.253	15.98±0.699	17.97±0.806
Sig	0.000	0.000	0.000	0.000

•=The mean difference is significant at the 0.05 level according Tukey test.

•=Test treat between Nutrition and Magnetic field groups.

Table 4.8 The Correlation coefficients between variables for Left Leg (BMD, BMC, T-score and Z-score).

	left leg BMD	left leg BMC	left leg T-score	left leg Z-score
left leg BMD	1	.482**	.944**	.911**
left leg BMC		1	.485**	.589**
left leg T-score			1	.918**
left leg Z-score				1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

4.4 Left ribs (BMD, BMC, T-score and Z-score)

The distribution of Left ribs (BMD, BMC, T-score and Z-score) among study sample (water, Tea and pellet) according to Mean, as appears below the Control Group (BMD = 0.04, BMC= 0.50, T-score = 4.81, Z-score = 5.00) , the highest mean value in BMD exists water (mean =0.23, SE ±0.025) the less value in pellet (mean = 0.19, SE ±0.005). According to BMC the highest mean value exists in Tea (mean= 28.07, SE ±0.827) less value in pellet (mean=11.93 SE ±2.162). While in T-score the highest mean value exists in water (mean= 18.23, SE ±0.620) less value in Pellet (mean = 14.71 SE ±0.552).While in Z-score the highest mean value exists in Water (mean= 20.42, SE ±0.911) less value in pellet(mean =16.90, SE ±0.891). According to the ANOVA Analysis, in group there is high accuracy statistically significant difference appears in Nutrition $p \leq 0.05$. [Table 4.9] [appendix 9].

Table 4.9 The distribution of Left ribs (BMD, BMC, T-score and Z-score) among study sample (water, Tea, pellet and control) according to Mean and Str. Error of Mean .

Nutrition	Left ribs BMD	Left ribs BMC	Left ribs T-score	Left ribs Z-score
Water	0.23±0.025 a	19.71±1.913 b	18.23±0.620 a	20.42±0.911 a
Tea	0.18±0.012 b	28.07±0.827 a	17.38±1.157 a	17.85±0.926 b
Pellet	0.16±0.004 c	11.93±2.162 c	14.71±0.552 b	16.90±0.891 b
Control	0.04±0.001 d	0.50±0.021 d	4.81±0.208 c	5.00±0.204 c
Total	0.15±0.0105	15.05±1.23	13.782±0.634	15.04±0.733
Sig.	0.000	0.000	0.000	0.000

•=The mean difference is significant at the 0.05 level according Tukey test.

•=Test treat between Nutrition groups.

The distribution of Left ribs (BMD, BMC, T-score and Z-score) among magnetic fields (1400, 4200 and 7000 rolls) according to Mean, as appears below the Control Group (BMD = 0.04, BMC= 0.50, T-score = 4.81, Z-score = 5.00), the highest mean value in BMD exists 4200 roll (mean =0.24, SE ±0.011) the less value in 7000 roll (mean = 0.15,SE ±0.004). According to BMC the highest mean value exists in 4200 roll (mean= 27.23, SE ±0.748) less value in 1400 roll (mean=16.22 SE ±2.764) . While in T-score the highest mean value exists in 1400 roll (mean= 18.09, SE ±1.090) less value in 7000 roll (mean = 14.28 ,SE ±0.503). While in Z-score the highest mean value exists in 4200 roll (mean= 20.38, SE ±0.939) less value in 7000 roll (mean = 16.61, SE ±0.849).According to the ANOVA Analysis, in group there is high accuracy statistically significant difference appears in Magnetic field $p \leq 0.05$. **[**Table 4.10] [appendix 10]

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Table 4.10 The distribution of Left ribs (BMD, BMC, T-score and Z-score) among magnetic fields (1400, 4200, 7000 rolls and control) according to Mean and Str. Error of Mean.

Magnetic field	Left ribs BMD	Left ribs BMC	Left ribs T-score	Left ribs Z-score
1400	0.18±0.011b	16.22±2.764 b	18.09±1.090 a	18.19±0.924 b
4200	0.24±0.023 a	27.23±0.748 a	17.95±0.677 a	20.38±0.939 a
7000	0.15±0.004 c	16.26±1.818 b	14.28±0.503 b	16.61±0.849 c
Control	0.04±0.001 d	0.50±0.021 c	4.81±0.208 c	5.00±0.204 d
Total	0.152±0.009	15.05±1.337	13.78±2.478	15.04±0.729
Sig.	0.000	0.000	0.000	0.000

•=The mean difference is significant at the 0.05 level according Tukey test.

•=Test treat between Magnetic field groups.

The treatment of Left ribs (BMD, BMC, T-score and Z-score) Multiplying with (nutrition × magnetic field)according to Mean, as appears below the control group (BMD = 0.04, BMC= 0.50, T-score = 4.81, Z-score = 5.00) , the highest mean value in BMD exists in water T2 (mean =0.39,SE ±0.018) the less value in Tea T3 (mean = 0.13 ,SE ±0.005). According to BMC the highest mean value exists in Tea T1 (mean= 32.33,SE ±0.213) less value in pellet T1(mean=2.33, SE ±0.467). While in T-score the highest mean value exists in Tea T1 (mean= 24.28, SE ±0.778) less value in Tea T3 (mean = 13.00,SE ±0.308). While in Z-score the highest mean value exists in water T2 (mean= 24.14, SE ±0.704) less value in pellet T3 (mean =13.00, SE ±0.436). According to the ANOVA Analysis, in group there is high accuracy statistically significant difference appears in groups of Nutrition × Magnetic field $p \leq 0.05$. [Table 4.11] [appendix 11].

Table 4.11 The distribution of Left ribs (BMD, BMC, T-score and Z-score) treatment multiplying with (nutrition × magnetic field and control) according to Mean and Str. Error of Mean.

	Left ribs BMD	Left ribs BMC	Left ribs T-score	Left ribs Z-score
Water 1400	0.14±0.001 de	14.00±0.275 d	16.71±0.606 cd	15.57±1.087 b
Water 4200	0.39±0.018 a	31.75±0.436 a	21.28±0.680 b	24.14±0.704 a
Water 7000	0.17±0.002 cd	13.38±0.278 d	16.71±0.837 cd	21.57±0.428 a
Tea 1400	0.25±0.007 b	32.33±0.213 a	24.28±0.778 a	23.14±0.633 a
Tea 4200	0.16±0.006cde	24.83±0.443 c	14.85±0.704 de	15.14±0.961 b
Tea 7000	0.13±0.005 e	27.05±1.290 b	13.00±0.308 e	15.28±0.521 b
Pellet 1400	0.14±0.002 de	2.33±0.195 f	13.28±0.606 e	15.85±0.911 b
Pellet 4200	0.19±0.001 c	25.13±0.335bc	17.71±0.420 c	21.85±0.340 a
Pellet 7000	0.14±0.001 de	8.357±0.311 e	13.14±0.508 e	13.00±0.436 b
Control	0.04±0.001 f	0.50±0.021 g	4.81±0.208 f	5.00±0.204c
Total	0.16±0.010	15.98±1.355	14.35±0.677	15.68±0.751
Sig	0.000	0.000	0.000	0.000

•=The mean difference is significant at the 0.05 level according Tukey test.
•=Test treat between Nutrition and Magnetic field groups.

Table 4.12 The Correlation coefficients between VARIABLES for left ribs (BMD, BMC, T-score and Z-score).

	Left ribs BMD	left ribs BMC	left ribs T-score	left ribs Z-score
left ribs BMD	1	.757**	.824**	.837**
left ribs BMC		1	.795**	.766**
left ribs T-score			1	.905**
left ribs Z-score				1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

4.5 Left arm (BMD, BMC, T-score and Z-score)

The distribution of Left arm (BMD, BMC, T-score and Z-score) among study sample (water, Tea and pellet) according to Mean, as appears below the control group (BMD = 0.04, BMC= 0.50, T-score = 4.81, Z-score = 5.00), the highest mean value in BMD exists Tea (mean =0.29, SE ±0.016) the less value in pellet (mean = 0.24, SE ±0.012). According to BMC the highest mean value exists in Tea (mean= 84.09, SE ±13.274) less value in Water (mean=18.18, SE ±2.757). While in T-score the highest mean value exists in water (mean= 33.66, SE ±2.109) less value in Pellet (mean = 26.95, SE ±1.375). While in Z-score the highest mean value exists in Water (mean= 34.09, SE ±0.044) less value in Tea (mean = 32.09, SE ±2.418) .According to the ANOVA Analysis, in Nutrition group no statistically significant difference appears only in Left arm – Z-score $p \leq 0.05$. [Table 4.13] [appendix 12].

Table 4.13 The distribution of Left arm (BMD, BMC, T-score and Z-score) among study sample (water, Tea, pellet and control) according to Mean Str. Error of Mean.

Nutrition	Left arm BMD	Left arm BMC	Left arm T-score	Left arm Z-score
Water	0.27±0.018 a	49.24±3.711 b	33.66±2.109 a	34.09±3.044 a
Tea	0.29±0.016 a	84.09±13.274 a	31.47±2.858 a	32.09±2.418 b
Pellet	0.24±0.012 b	18.18±2.757 c	26.95±1.375 b	33.04±1.648ab
Control	0.04±0.001 c	0.50±0.021 d	4.81±0.208 c	5.00±0.204 c
Total	٠.21±0.011	38.00±4.940	24.22±1.637	26.055±1.828
Sig	0.000	0.000	0.000	0.044

•=The mean difference is significant at the 0.05 level according Tukey test.

•=Test treat between Nutrition groups.

The distribution of Left arm (BMD, BMC, T-score and Z-score) among magnetic fields (1400, 4200 and 7000 rolls) according to Mean, as appears below the control group (BMD = 0.04, BMC= 0.50, T-score = 4.81, Z-score = 5.00), the highest mean value in BMD exists 4200 roll (mean =0.29, SE ±0.019) the less value in 7000 roll (mean = 0.23, SE ±0.011). According to BMC the highest mean value exists in 1400 roll (mean= 73.30, SE ±15.515) less value in 7000 roll (mean=29.03, SE ±2.002) . While in T-score the highest mean value exists in 1400 roll (mean= 34.14, SE ±2.736) less value in 7000 roll (mean = 23.90, SE ±1.226). While in Z-score the highest mean value exists in 4200 roll (mean= 40.33, SE ±2.408) less value in 7000 roll (mean = 25.90, SE ±1.303). In Magnetic field group a high accuracy statistically significant difference appears $p \leq 0.05$. [Table 4.14] [appendix 13].

Table 4.14 The distribution of Left arm (BMD, BMC, T-score and Z-score) among magnetic fields (1400, 4200, 7000 rolls and control) according to Mean Str. Error of Mean.

Magnetic field	Left arm BMD	Left arm BMC	Left arm T-score	Left arm Z-score
1400 roll	0.27±0.019 a	73.30±15.515 a	34.14±2.736 a	33.00±2.286 b
4200 roll	0.29±0.016 a	49.18±3.522 b	34.04±1.797 a	40.33±2.408 a
7000 roll	0.23±0.011 b	29.03±2.003 c	23.90±1.226 b	25.90±1.303 c
Control	0.04±0.001 c	0.50±0.021d	4.81±0.208 c	5.00±0.204 d
Total	0.207±0.011	38.00±5.265	24.22±1.491	26.057±1.55
Sig.	0.000	0.000	0.000	0.000

•=The mean difference is significant at the 0.05 level according Tukey test.

•=Test treat between Magnetic field groups.

The treatment of Left arm (BMD, BMC, T-score and Z-score) Multiplying with (nutrition × magnetic field) according to Mean, as appears below the control group (BMD = 0.04, BMC= 0.50, T-score = 4.81, Z-score = 5.00), the highest mean value in BMD exists in water T2 (mean =0.38, SE ±0.005) the less value in pellet T3 (mean = 0.18, SE ±0.008). According to BMC the highest mean value exists in Tea T1 (mean= 167.36, SE ±3.055) less value in pellet T1(mean=3.03, SE±0.369). While in T-score the highest mean value exists in Tea T1 (mean= 48.42, SE±1.212) less value in Tea T3 (mean = 19.28, SE ±1.062). While in Z-score the highest mean value exists in water T2 (mean= 52.57, SE±1.065) less value in water T3 (mean = 21.71, SE ±1.409). In Nutrition × Magnetic field group a high accuracy statistically significant difference appears $p \leq 0.05$. [Table 4.15] [appendix 14].

Table 4.15 The distribution of Left arm (BMD, BMC, T-score and Z-score) treatment multiplying with (nutrition × magnetic field and control) according to Mean and Str. Error of Mean.

	Left arm BMD	Left arm BMC	Left arm T-score	Left arm Z-score
Water 1400	0.24±0.007 b	49.52±2.465 c	34.57±1.306 b	28.00±0.975 e
Water 4200	0.38±0.005 a	68.62±1.983 b	44.00±1.290 a	52.57±1.065 a
Water 7000	0.18±0.008 c	29.58±0.841 f	22.42±1.461 de	21.71±1.409 g
Tea 1400	0.38±0.013 a	167.36±3.055 a	48.42±1.212 a	46.85±1.261 b
Tea 4200	0.24±0.014bc	46.37±2.965 cd	26.71±1.628 cd	26.71±0.521ef
Tea 7000	0.25±0.018 b	38.54±2.336 de	19.28±1.062 e	22.71±0.892 g
Pellet 1400	0.18±0.008 c	3.03±0.369 h	19.42±1.250 e	24.14±0.704fg
Pellet 4200	0.27±0.022 b	32.56±1.036ef	31.42±1.172bc	41.71±0.644 c
Pellet 7000	0.26±0.017 b	18.96±1.410 g	30.00±1.290bc	33.28±0.714 d
Control	0.04±0.001 d	0.50±0.021 h	4.81±0.208 f	5.00±0.204 h
Total	0.22±0.012	40.38±5.104	25.45±1.567	27.39±1.690
Sig.	0.000	0.000	0.000	0.000

•=The mean difference is significant at the 0.05 level according Tukey test.

•=Test treat between Nutrition groups.

Table 4.16 The Correlation coefficients between the variables for left arm (BMD, BMC, T-score, Z-score).

	left arm BMD	Left arm BMC	Left arm T-score	Left arm Z-score
left arm BMD	1	.733**	.893**	.902**
left arm BMC		1	.785**	.680**
left arm Tscore			1	.931**
left arm Zscore				1

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

4.6 Fracture risk models

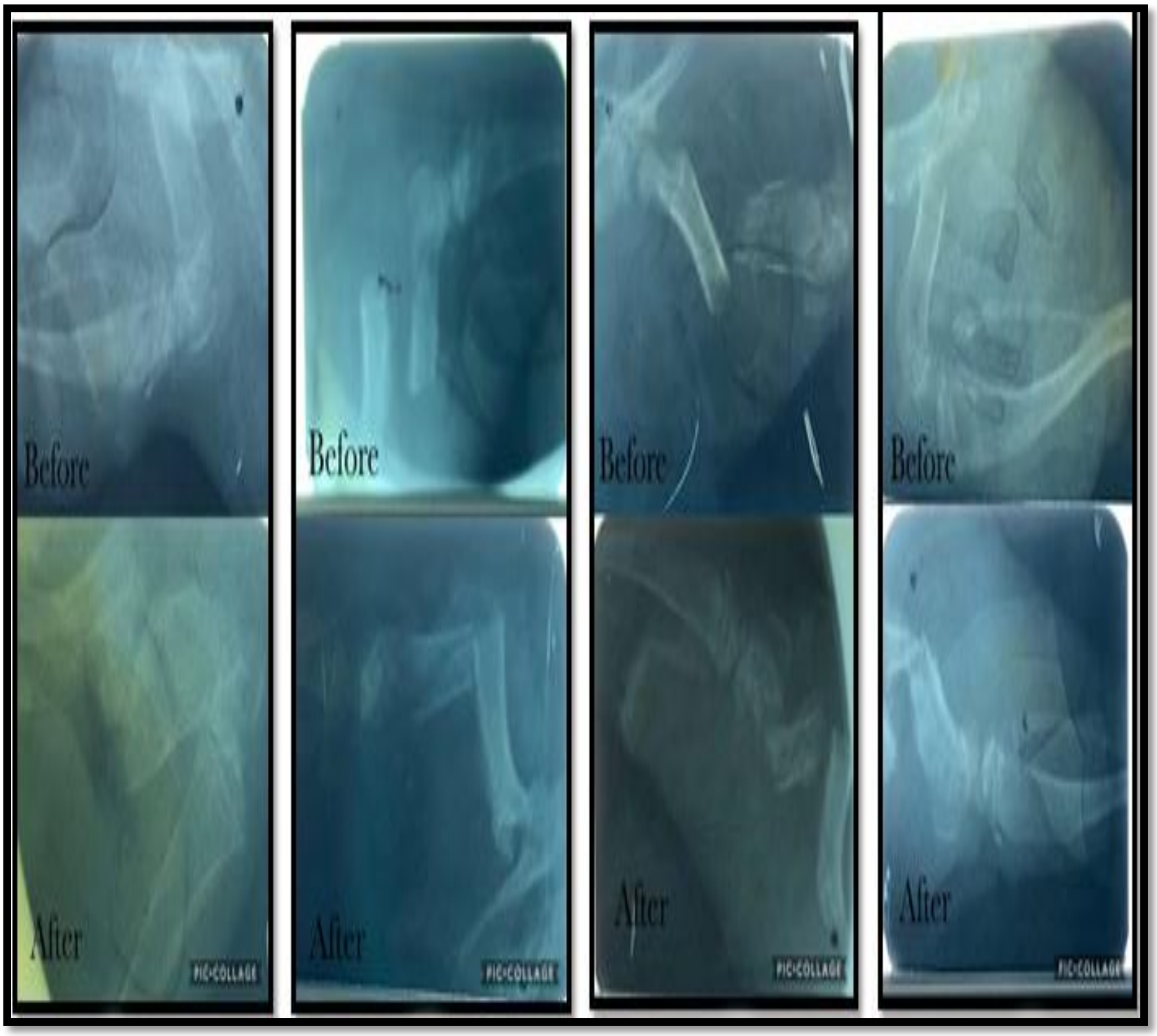
The fractures have created manually post rat samples to general anesthesia with injection an aesthetic(Ketamine Hydride USP: ketamine 50 mg/ml for i.m./i.v. injection ; Batch NO. :70407 ; Germany), and a dose of general analgesia (0.01 mg/kg) was given intramuscularly with very low damage to the surrounding soft tissues in order to allow the preservation of the early biological response to trauma, which is not the case of fracture though surgical procedure **[90]**.

The energy is needed to create the fracture perfectly that controlled when considered in comparison with other fracture procedure, with a highly standardized amount of energy. Originally with advantages of limiting the occurrence of complications related to the current approach of femur fracture accurately. This approach proved to be fast and safe, with no deep infection reported. Moreover, all the rats in the study ambulated within 21 hours after awakening. Finally, to the best of our knowledge, there is no evidence showing any correlation between fracture approach and bone healing of the femur.

The quality criteria used to assess a fracture created from an rats model are usually its pattern in this study, 12 rats animals exhibited accept able criteria of fracture , thus rat models exposed to nutrition's that had high level of magnetization (water with tap 1400 rolls, Tea with tap 1400 rolls, and pellet with tap 4200 rolls) throughout current study reported a significantly higher fractures healing than the control group. In fact, numerous issue observed given the fact that significant bending could jeopardize.

To the best of our knowledge this study is the first to assess the fracture that created from an animal model with a high-resolution X-ray device as Figure (4.1) that revels rats model femur fracture and after haling yet must give the fact that significant fracture could jeopardize rat safety.

However, with the use of a high-resolution imaging device, subsequent improvements have reported about rat model of fracture evaluating the potential influence of the bone healing process in 14 days period of improvement for rat model groups that have been given the nutrition (water, Tea, and pellet) exposed to magnetic field intensity while healing process for the control group last for 21 days according to density tests done by X-ray imaging technique to assess fracture risk via measurement of (BMD, BMC, T- score and Z- score) values illustrated above. This finding suggests that exposing to magnetized nutrition(water, Tea, pellet) could have an influence on the early phase of fracture healing [figure 4.1].



(a) (b) (c) (d)

Figure 4.1 X- ray unit images showing the range of fractures and healing according to magnetized nutrition ; water, tea, pellet and control group as well

a) rat femur (left leg) water group, b) rat femur (left leg) Tea group, c) rat femur (left leg) Pellet group and d) rat femur (left leg) control group.

4.7 Magnetic hysterics curve

Current study has encountered an issue that lies in usage of selected magnetic tapes, when starting to magnetize media of the study (Water, Tea, Pellet) changes at levels of magnetic flow at each Tap in general (1400, 2800,4200, 5600 and 7000 that which flow level ranging from levels 1.5 , 1.9, 0.9, 0.5, 0.3 (mT) respectively, According to chosen taps, flow start to raise at 1400 tap to be at top level calculated at 2800 tap and then stoop to lowest level at 7000 tap causing magnetic hysterics curve . [Figure 4.2].

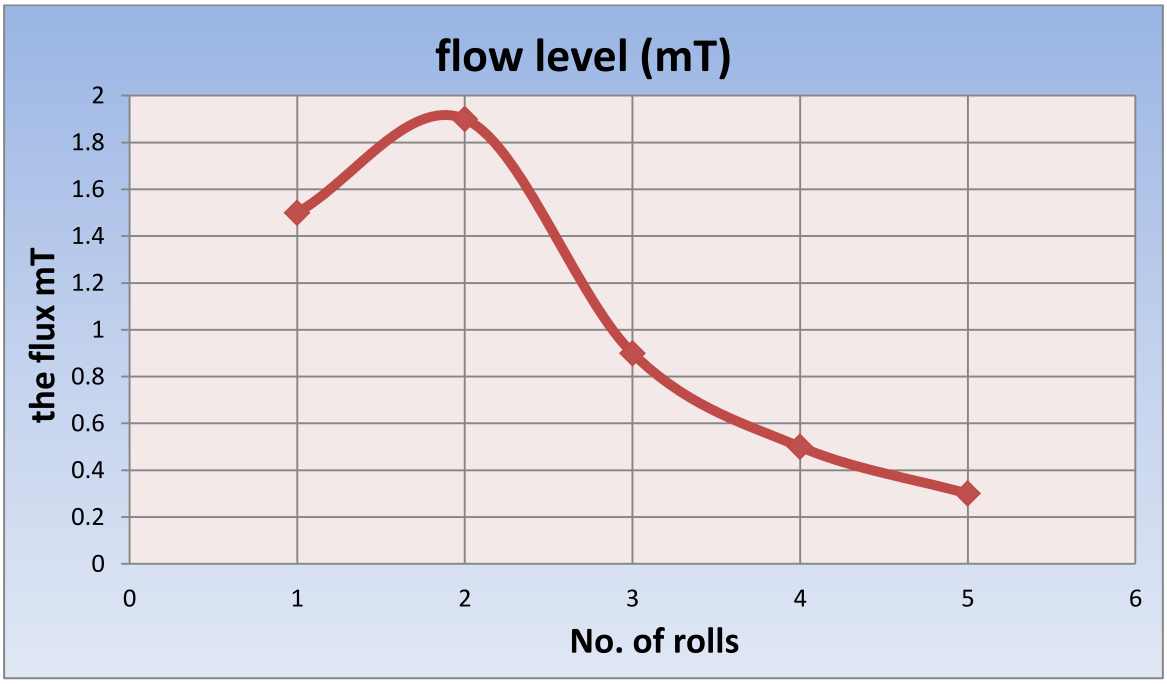
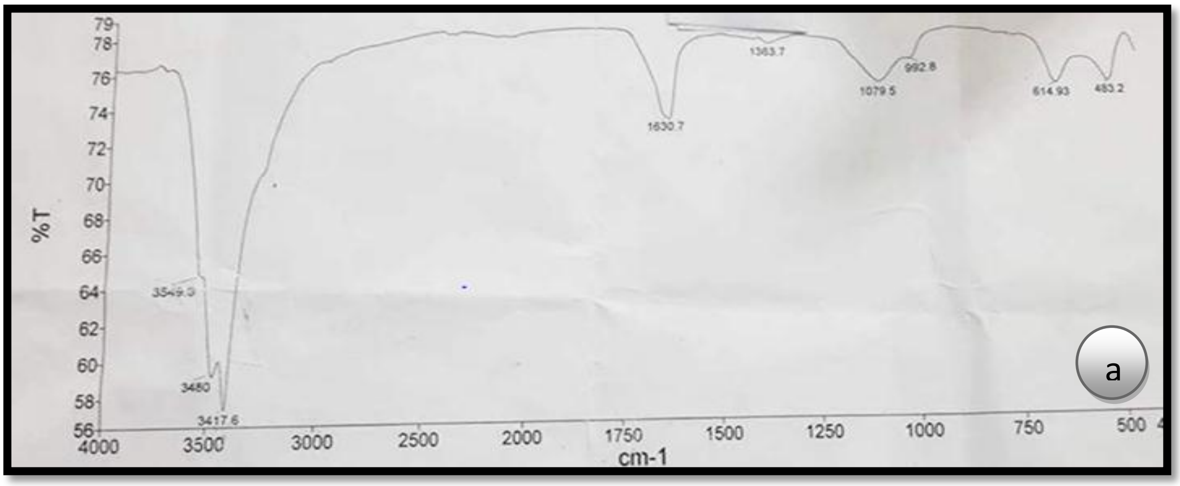


Figure 4.2 shows changing levels of magnetic flow at each Tap

Magnetic hysterics occurs in iron which considered as substance magnetic failure of magnetic field which is the opposite of the save which is magnetic flow intensity for substance. When lack of magnetic field equals zero, means that magnetic field of huge and wide permanent quality magnetic failure curve area for magnets, when removed magnetic field , the opposite fielded, is large thus substance saves magnetism for long time while substants with temporary magnetic have small and tite closed magnetic failure curve area thus removed magnetic field is small **[91]**

4.8 magnetizing different kind of Green Tea

The Selenium affects bone stiffness, Throughout the study, a problematic action encountered when magnetizing another kind the green tea with mint extract different brand than what been used earlier of experiment) rather than the original one , resulting changes at the Tap 1400 of tea color because of difference of longitudinal waves for some of the Tea compounds and after green tea analysis with FTIR Devise IR before and after magnetic [figure 4.4].



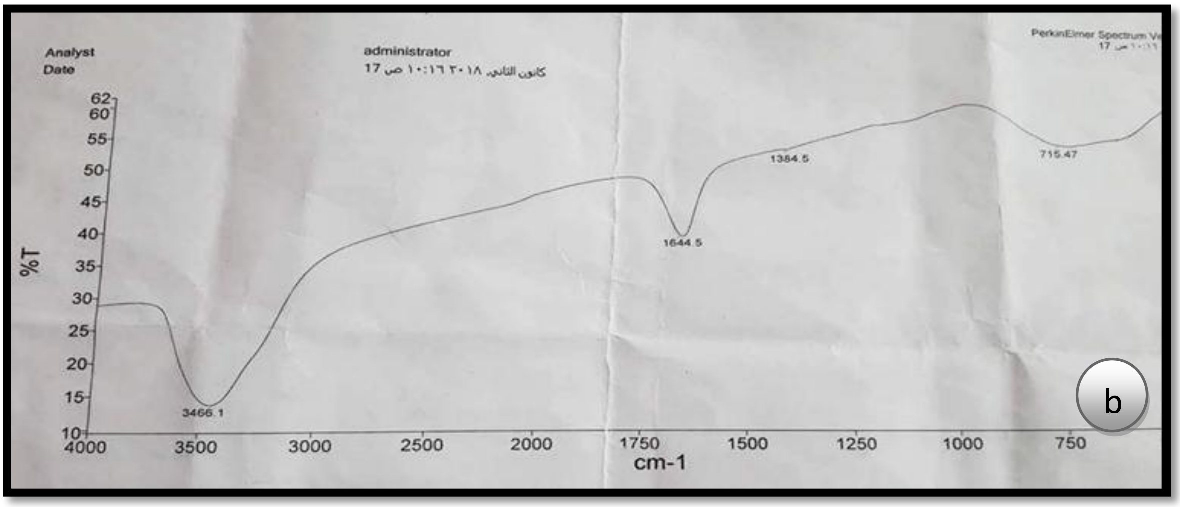


Figure 4.3 shows before (a) and after (b) magnetic process shapes.

Before magnetic process, on 3549.3 stretching has become after magnetic analysis with FTIR Devise IR 3466.1 stretching in which the bond OH Phenol stretched (stretching vibrations) for Tea structure contains five Hydroxide groups also galic acid component contains one phenol group. Spectrum radiology infrared reveals the Hydroxide groups that belong to Phenol components appearing in Spectrum between (3200 – 3600). At this point, the shift called hydpsochromic shift or in other words Blue Shift which is pack shift absorption to shorter wavelength as a result of compensating or solvent effect .

However, 3480 and 34176 stretching that NH2 bond stretch (stretching vibrations) exists in theanin disappears where the H in NH2 displaced and vanished. While before magnetic process on 1630.7 stretching has became after magnetic process on 1400 Tap 1644.5 stretching in which the bond C=N stretched (stretching vibrations) that exists in caffeine component where the resulted displacement considered as a Red Shift (Bathochromic Shift) which is pack shift absorption to longer wavelength as a result of compensating or solvent effect.

However, before magnetic process on 1363.7 stretching has became after magnetic process on 1384.5 stretching in which the bond (C-N) stretched (stretching vibrations) that exists in caffeine and thean in where the resulted displacement considered as a Red Shift (Bathochromic Shift) which is pack shift absorption to longer wavelength as a result of compensating or solvent effect.

While on 1079.5 stretching result disappearance due to bond (C-O) stretched (stretching vibrations). As on 992.3 stretching after magnetic process became on 715.47 stretching in which the bond (C-O) stretched resulting hydpsochromic shift or the Blue Shift which is pack shift absorption to shorter wavelength as a result of or solvent effect

Chapter Five

Conclusion and Recommendations and Suggestion

5.1 Conclusion

1- In conclusion, the current study that represented the effect of electromagnetic field and the simultaneous action of those fields on the intensity of bone turnover process in rats exhibited that magnetized Green Tea, water, and pellet by using system of magnetization, stimulation partially preserves bone mass, and bone structure by promoting skeletal activities in experimental rats, which are revealed by reducing the bone-building duration to two weeks compared to the control group, which was four weeks.

2- The underlying signals of electromagnetic failed may be included in the structural effects of bone density measured be DXA which is the best method of measuring bone density.

3- Experimental groups as well as the control pelvis, Left (leg, ribs, arm), (BMD, BMC, T-score and Z-score) due to magnetic fields (1400, 4200 and 7000 rolls) have been tested.

4- The results of current study showed the basic knowledge of bone activity and highlight nutrient magnetization as a safe and inexpensive method that may become a clinically applicable treatment for osteoporosis and effective treatment in fractures.

5- This study attempted to assess the potential impact of the magnetic field on the bone healing process in a small animal model of fracture. We have estimated that the final point selected later will be, the fewer differences that will be discover.

6- The importance of bone density measurement that determines the extent of bone formation early after fracture, have been decided to evaluate the relationship between magnetized nutrition and the early fracture insufficiency established at peak response to trauma, which is believed to be seven days after the initial trauma for the experimental group **[90]**.

7- Finally this study had been found a statistical link between magnetic fields (1400, 4200 and 7000 rolls) and (BMD, BMC, T-score and Z-score) ratios duration the procedure which considered as statistically significant difference in which ($p \leq 0.05$), This finding suggests that slight consuming of magnetic field exposed nutrition's could have an influence on the early phase of fracture healing, but its influence of the final healing is still unclear.

5.2 Recommendations

1- The results of current study indicate a remarkable performance of magnetized (water, green Tea and pellet) and might be suggested to use magnetized water as drinking water as well as consuming magnetized Green Tea for the purpose of entering in the treatment of fractures and osteoporosis.

2- Investigate the extent to which the magnetic field affects the degree of fertility, duration of pregnancy, and the time of pregnancy recurrence in the experimental group.

3- Further studies needed with magnetic water on a large sample of other commercial animal strains for the purpose of custom on the impact of exposure to the magnetic field and the rates of utilization of the consumption of magnetic materials.

5.3 Suggestion

- Study of Magnetism Effect on Pregnancy Time and the Health of the Embryos.
- Study the effect of magnetism on the effects of aging by studying the memory by periodically exposing the magnetic field to the brain.
- The possibility of re-study on other types of animals with larger sizes and their impact.

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Appendix

College of Medicine
University of Diyala

Ethical Committee for
Scientific research

كلية الطب
جامعة ديالى

اللجنة الأخلاقية للبحث العلمي

Number: 3

Date: 25/6/2018

Letter of Acceptance

The Scientific Ethical Committee in the College of Medicine, University of Diyala was approved that the research proposal submitted by **Nour Abd Alrazaq Hassan**, entitled **(The effect of magnetized nutrition on living bone)** under the scientific research with the necessary rules and regulations governing the ethics of scientific research, Scientific Ethical Committee decided to approve the research project and give the Ethical Number **(MDA42June2018NAH).**

Head of Scientific Ethical Committee

College of Medicine,

University of Diyala

Diyala university
college of Medicine
Admin.affairs

Appindix 1 : Letter of Acceptance

كۆماری عێراق
وەزارەتی تەندروستی
فەرمانگەی کلینیکە میللیەکان
سەنتەری نیشتمانی بۆچاودێری و لێکۆڵینەوە دەرمانەکان

جمهورية العراق
وزارة الصحة/ البيئة
دائرة العيادات الطبية الشعبية
المركز الوطني للرقابة والبحوث الدوائية
العدد: ٢٢٨
التاريخ: ٢ / ٨ / ٢٠١٧ م

إلى / دائرة الأمور الفنية / قسم الصيدلة
م/ فحص نماذج

تحية طيبة....
إشارة إلى كتاب قسم الإخراج الكمركي المرقم ٣٧٧٠ في ٢٠١٧/٦/١٥ و بعد ورود النماذج بتاريخ ٢٠١٧/٧/٦ ، تم إجراء الفحوصات الفيزياوية والكيمياوية و البايولوجية المبينة في التقارير المرفقة على النموذج المدرجة تفاصيله في أدناه وكانت النتائج مطابقة للمواصفات الدستورية .

Product name & packaging	Batch No.	Mfg. date	Exp. date	Batch's size	Manufacturer & C.O.O
Aneket ® 10 ml vial Ketamine Hydrochloride injection USP 50 mg/ml For IM / Slow IV / IV Infusion Use Pack of 1 vial of 10 ml	88419	04/2017	03/2019	20000 packs	NEON LABORATORIES LIMITED - INDIA

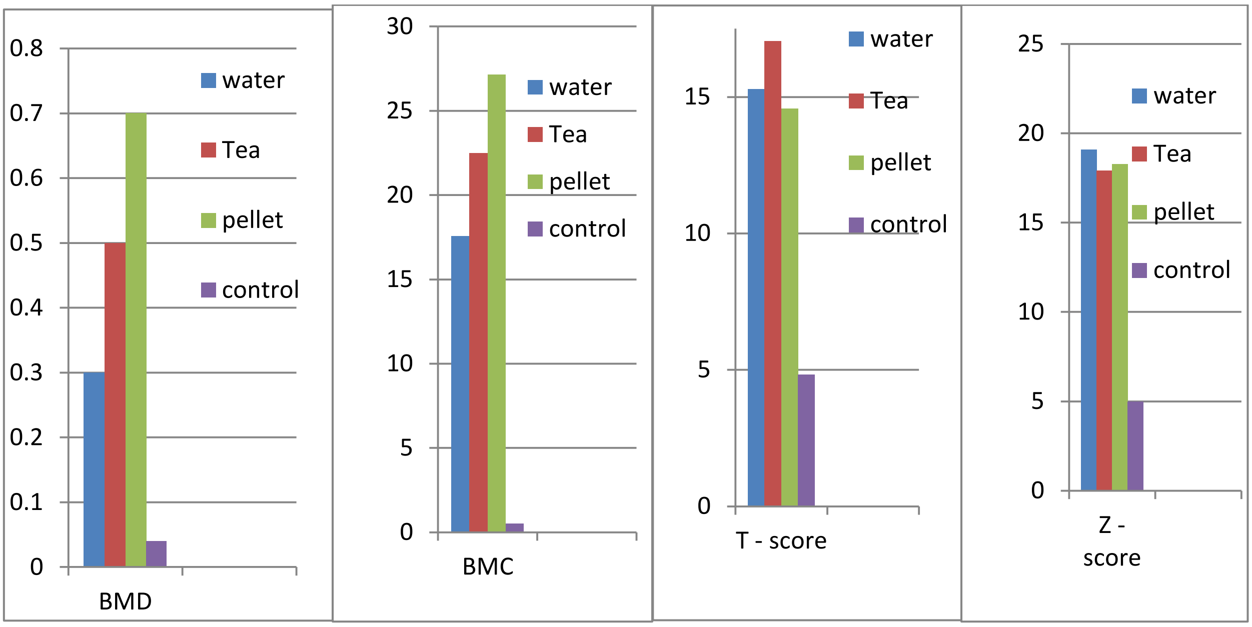
للتفضل بالاطلاع ... مع التقدير

المبلغ الكلي .... دينار
دفع مقدم المبلغ وقدره .... دينار بموجب توصل المرقم .... في ٦/٧/ ٢٠١٧
دفع باقي المبلغ وقدره .... دينار بموجب توصل المرقم .... في ٢/٨/ ٢٠١٧

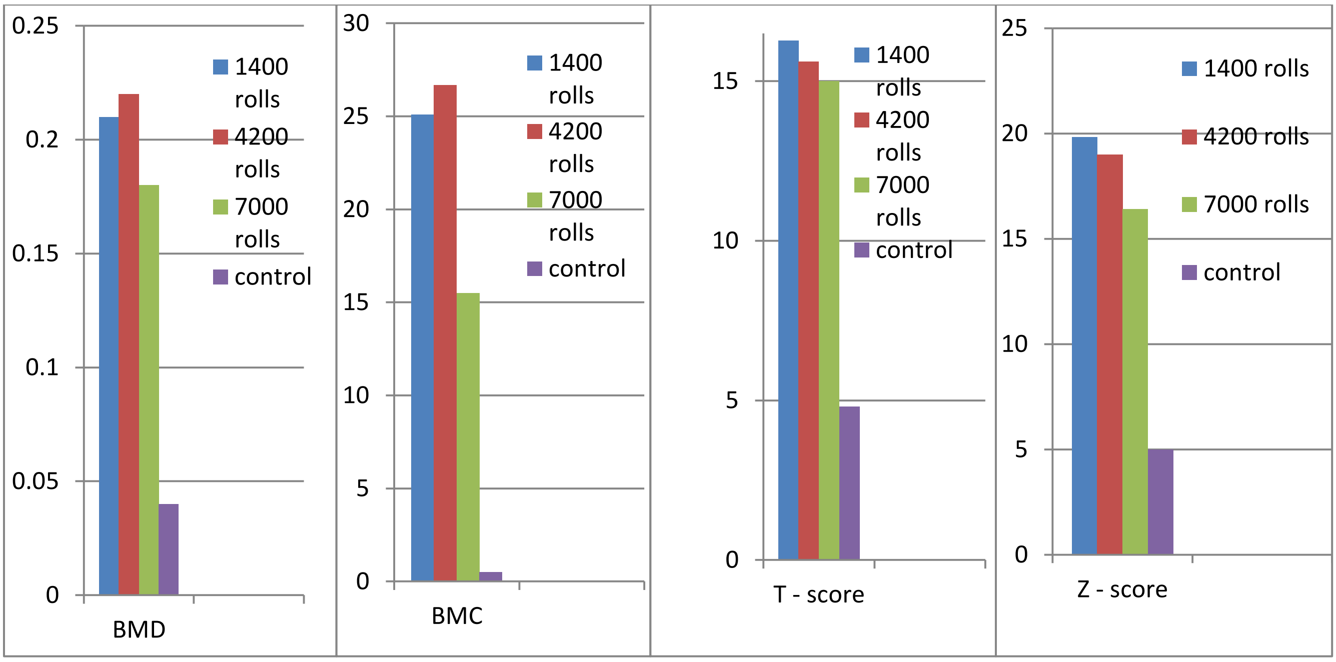
د.أحمد إسماعيل الشـنـر
م.مدير المركز الوطني للرقابة والبحوث الدوائية
٢/ ٨ / ٢٠١٧

نسخة منه إلى
- قسم الإخراج الكمركي / كتابكم أعلاه ... مع التقدير .
- دائرة العيادات الطبية الشعبية .
- ملف الدوام المسائي .
- مكتب الإعلام .

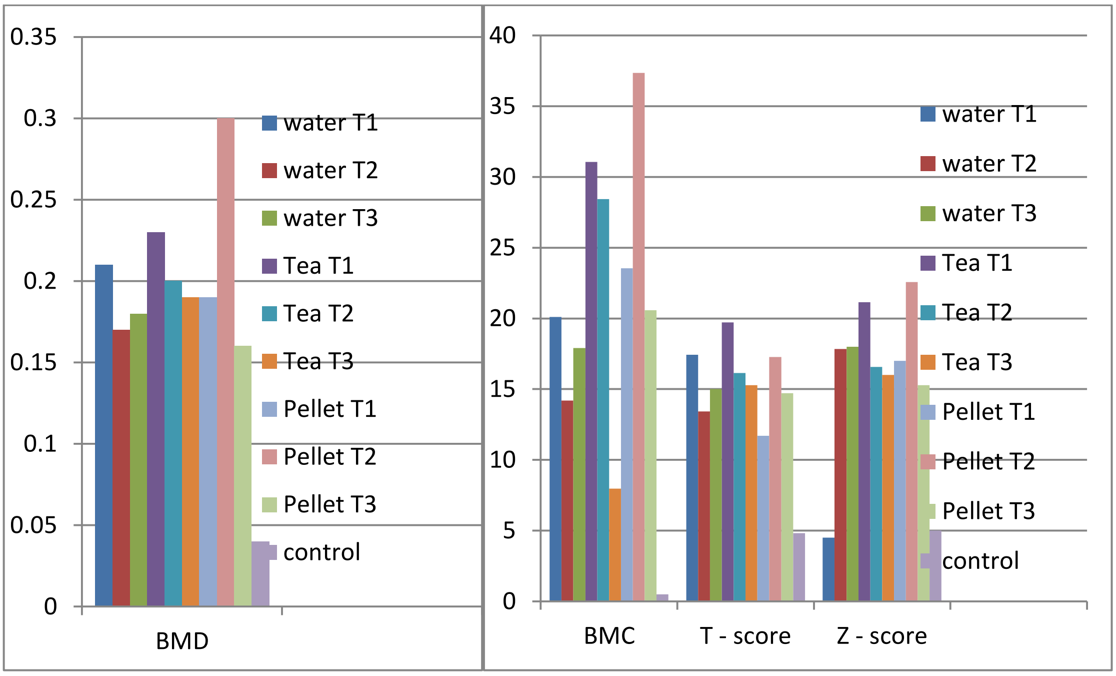
Appindix 2 : Ministry of Health, department of technical things , department of pharmacy, checking anesthesia model.



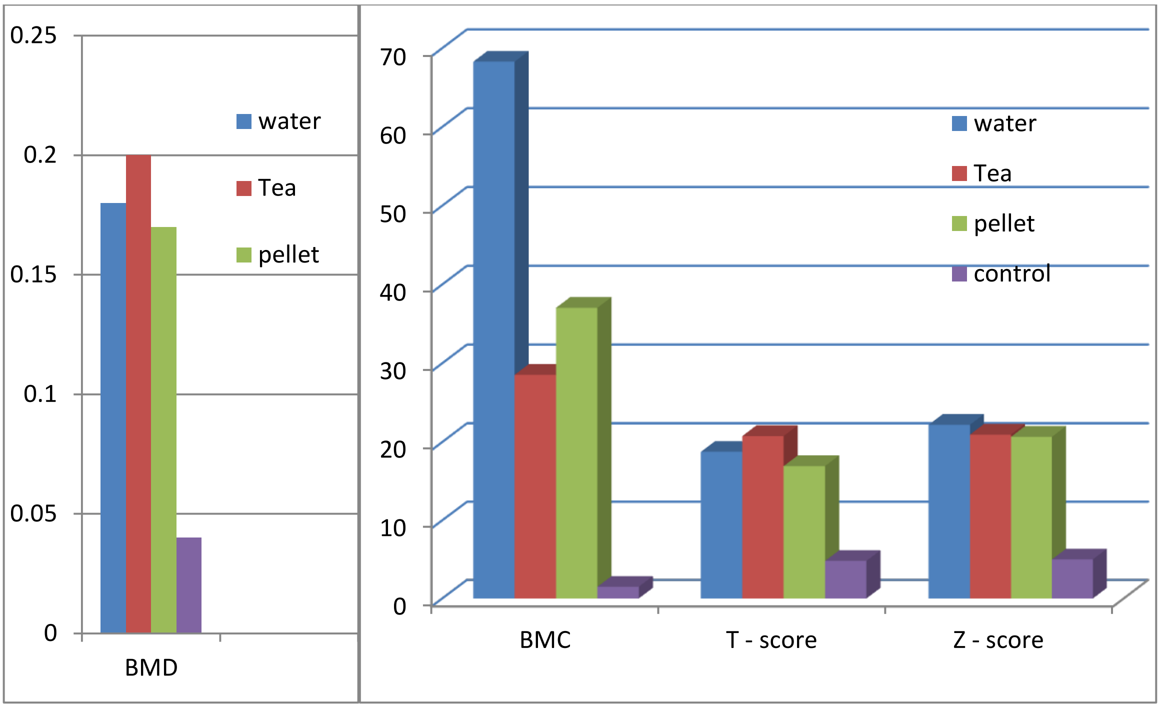
Appendix 3 depiction of pelvis (BMD, BMC, T-score and Z-score) due to study sample (water, Tea, pellet and Control).



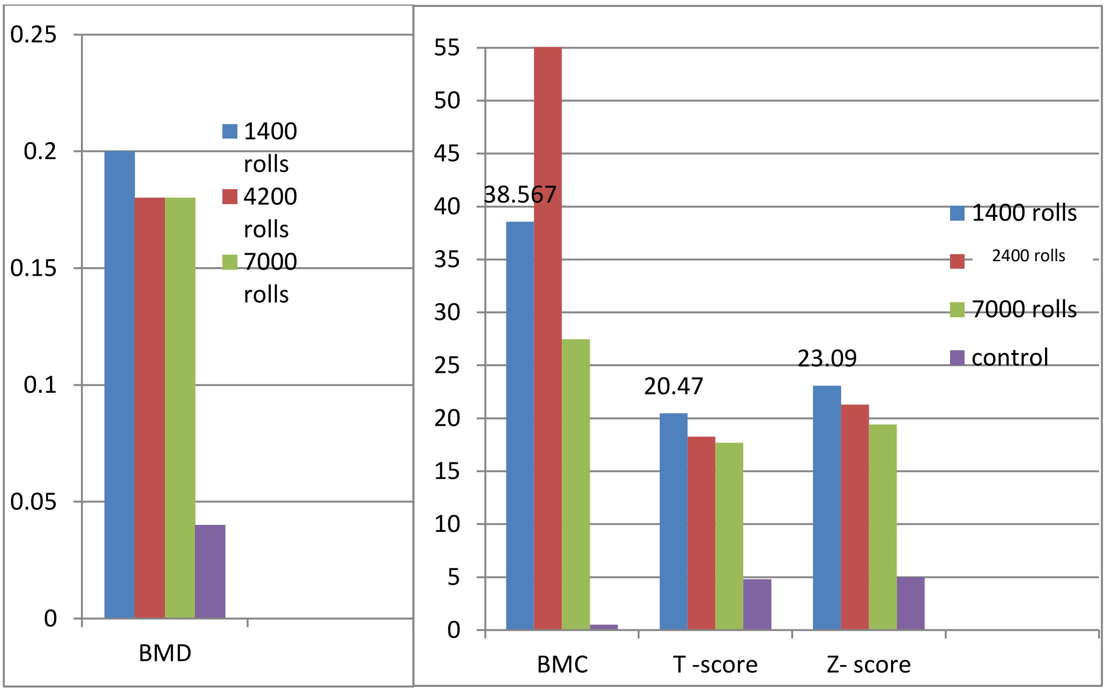
Appendix 4 depiction of pelvis (BMD, BMC, T-score and Z-score) due to magnetic fields (1400, 4200, 7000 rolls and control).



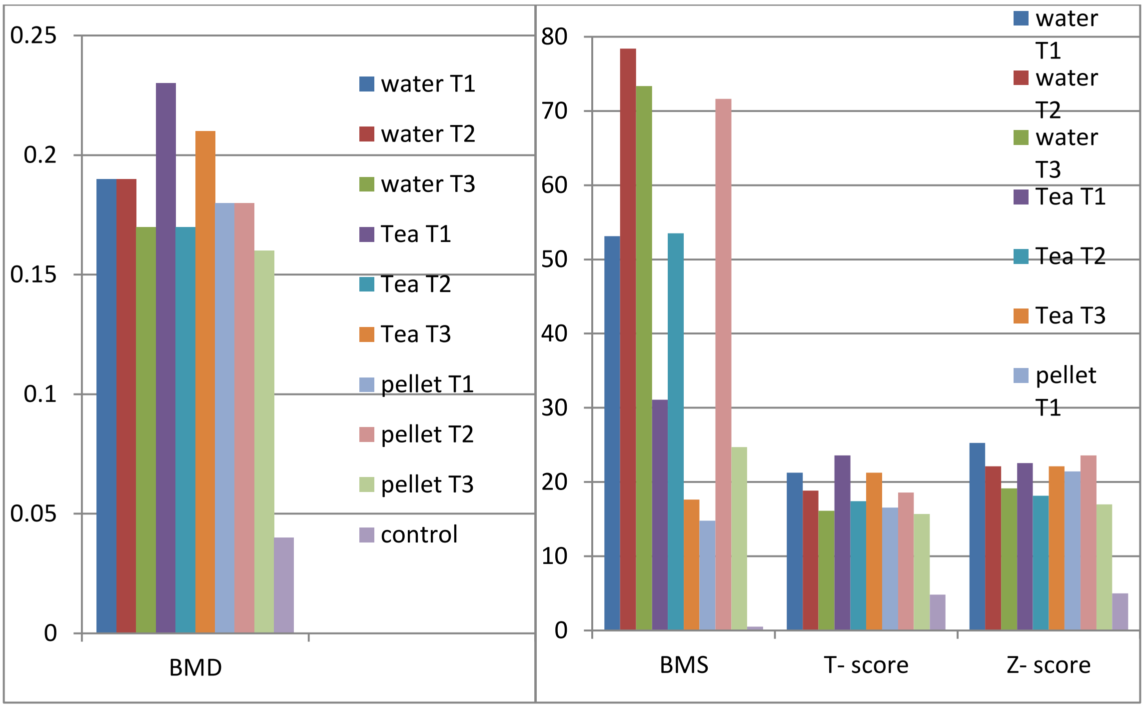
Appendix 5 depiction of pelvis (BMD, BMC, T-score and Z-score) due to(nutrition × magnetic field and control).



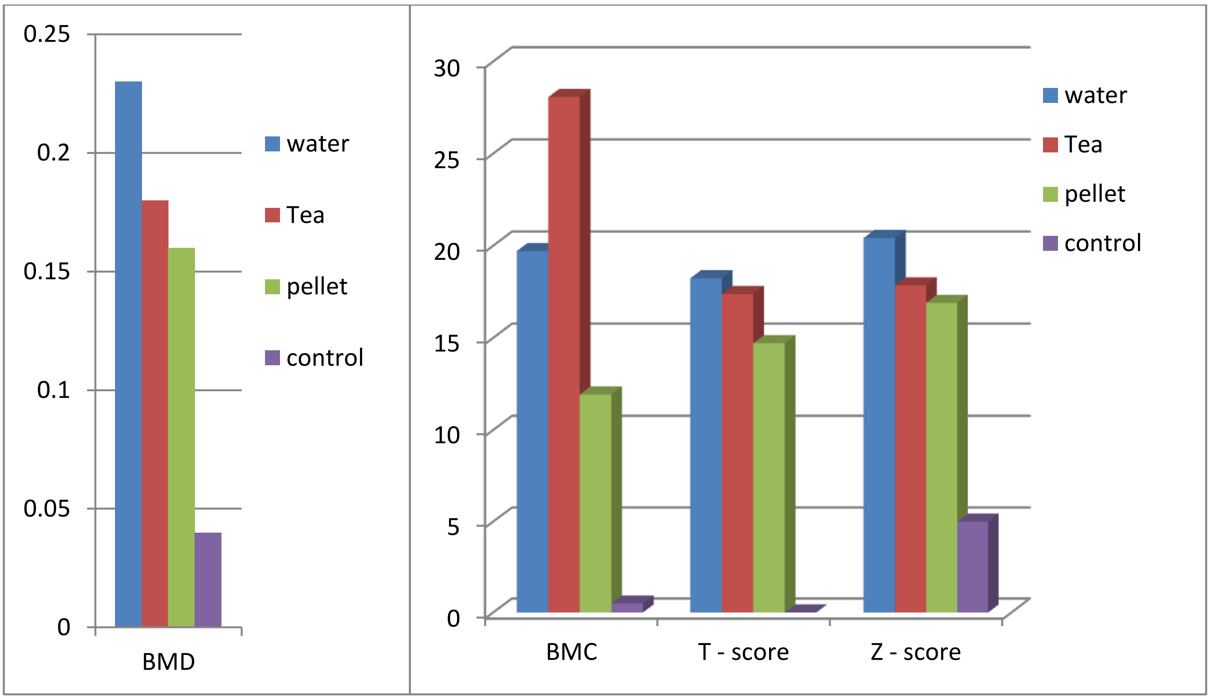
Appendix 6 depiction of Left leg (BMD,BMC,T-score and Z-score) due to study sample (water, Tea pellet and control).



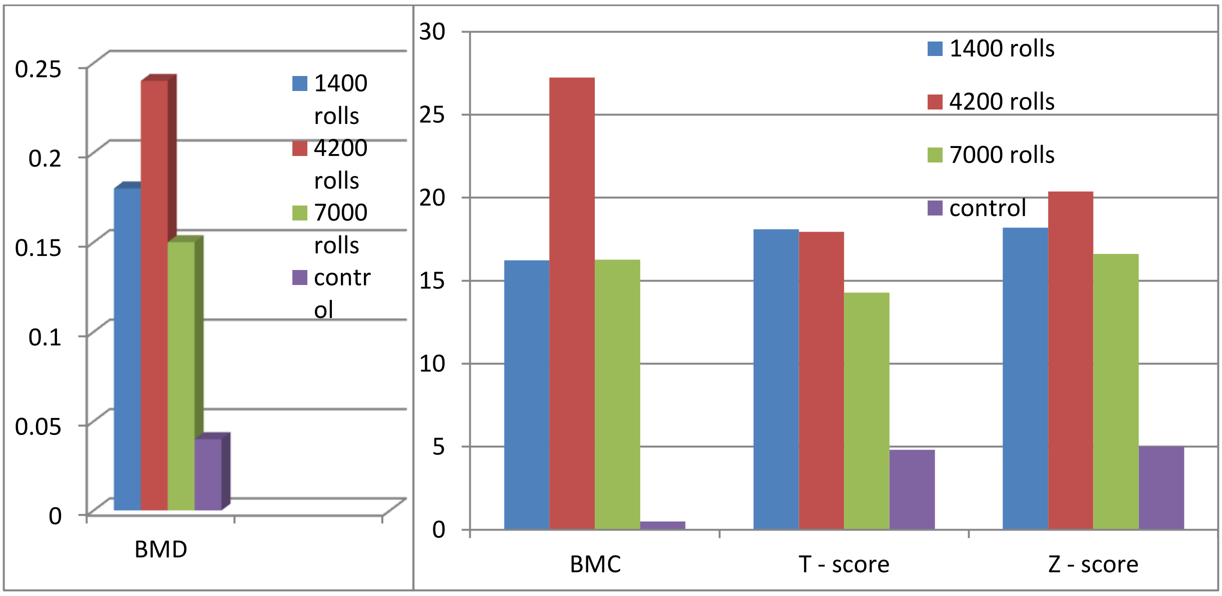
Appendix 7 depiction of Left leg (BMD,BMC,T-score and Z-score) due to magnetic fields (1400, 4200, 7000 rolls and control).



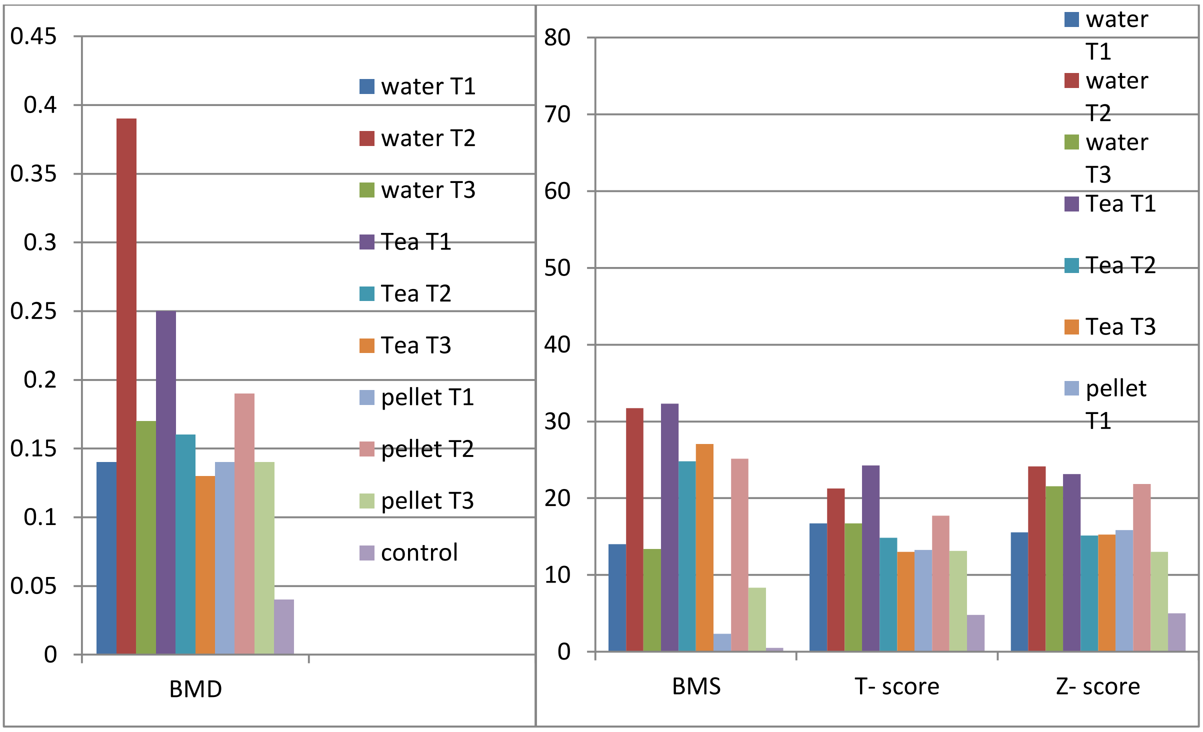
Appendix 8 depiction of Left leg (BMD,BMC,T-score and Z-score) due to (nutrition × magnetic field and control).



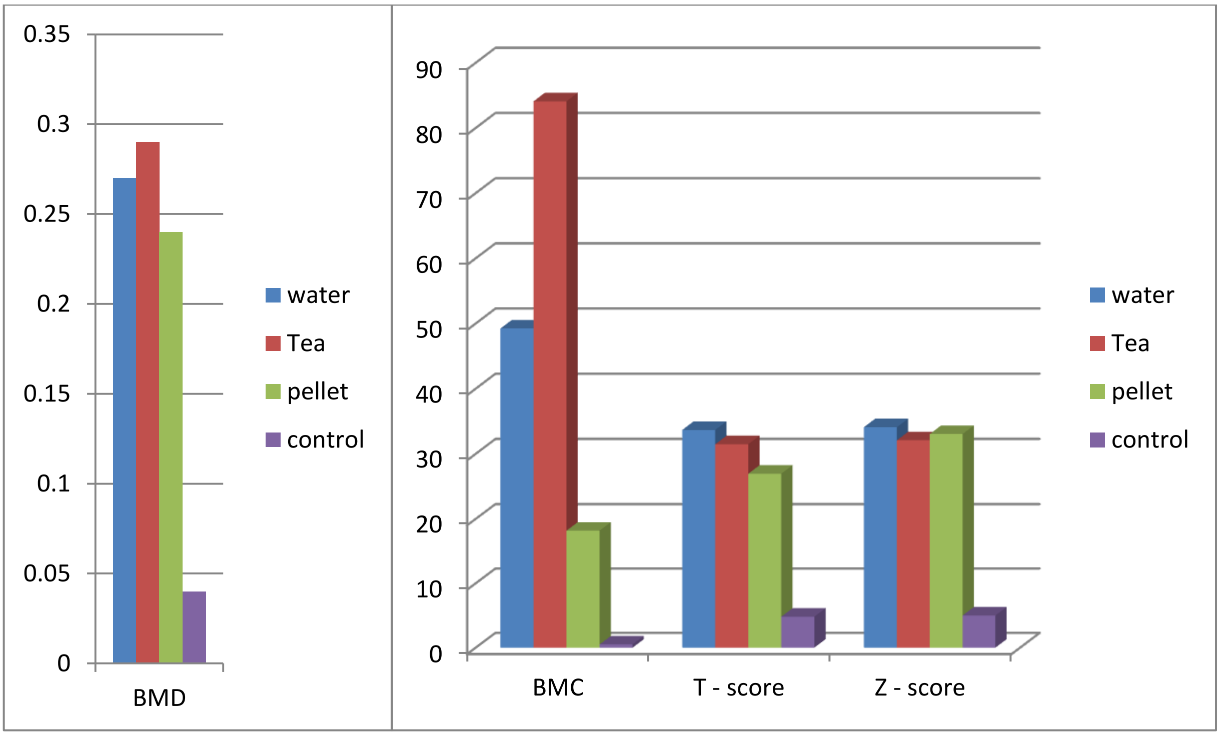
Appendix 9 depiction of Left ribs (BMD,BMC,T-score and Z-score) due to study sample (water, Tea, pellet and control).



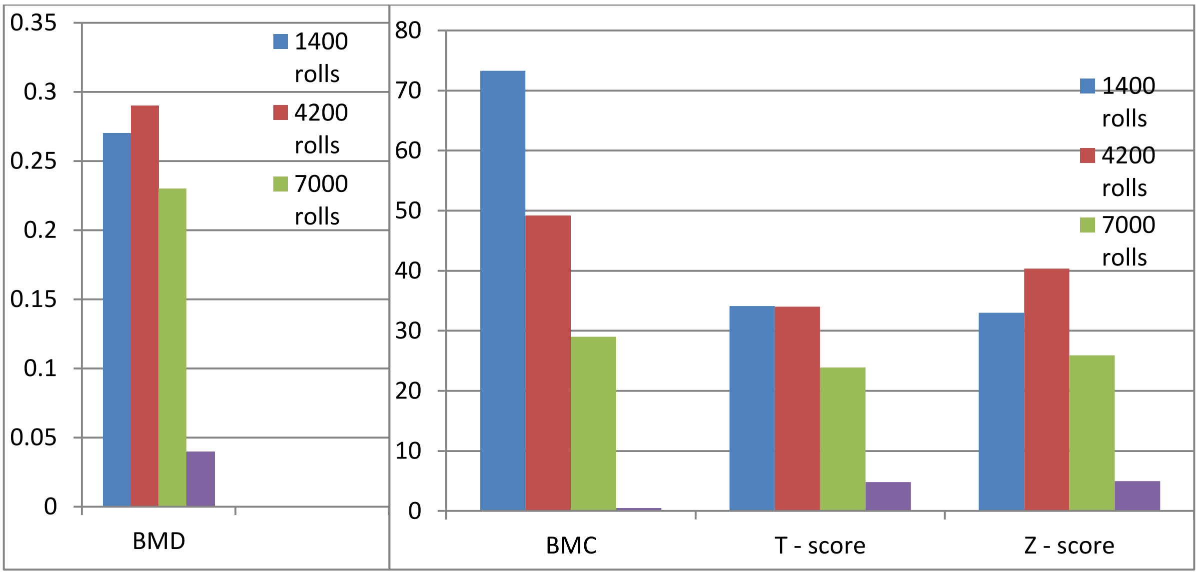
Appendix 10 depiction of Left ribs (BMD,BMC,T-score and Z-score) due to magnetic fields (1400, 4200, 7000 rolls and control).



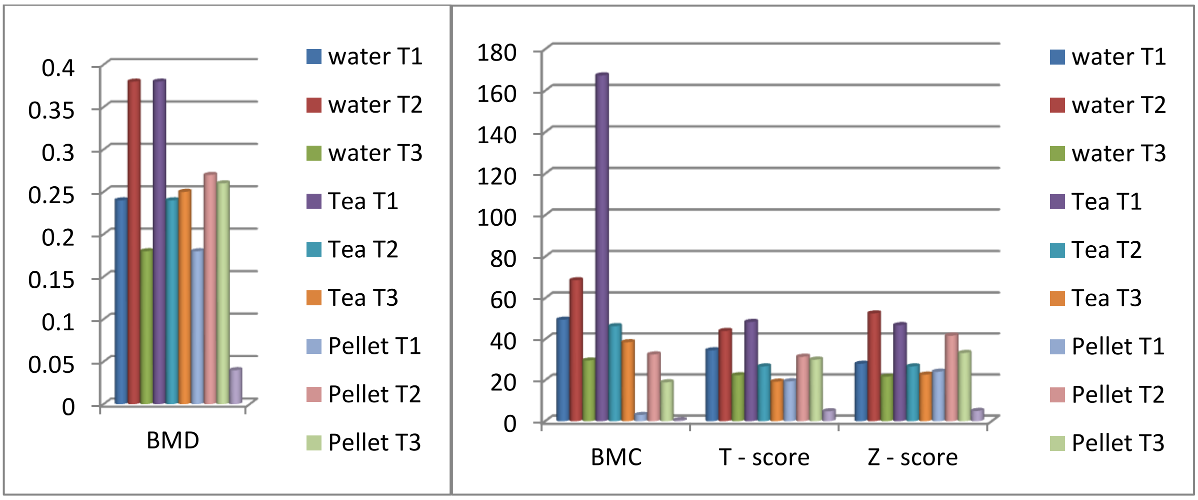
Appendix 11 depiction of Left ribs (BMD,BMC,T-score and Z-score) due to (nutrition × magnetic field and control).



Appendix 12 depiction of Left arm (BMD, BMC, T-score and Z-score) due to study sample (water, Tea, pellet and control).



Appendix 13 depiction of Left arm (BMD, BMC, T-score and Z-score) due to magnetic fields (1400, 4200, 7000 rolls and Control).



Appendix 14 : depiction of Left arm (BMD, BMC, T-score and Z-score) due to (nutrition × magnetic field and control).

جمهورية العراق

وزارة التعليم العالي والبحث العلمي

جامعة ديالى – كلية العلوم

قسم الفيزياء

تأثير التغذية الممغنطة على كثافة العظم

رسالة مقدمة إلى مجلس كلية العلوم – جامعة ديالى وهي جزء من متطلبات نيل درجة الماجستير في علوم الفيزياء

من قبل

نـــور عبد الـرزاق حســن

بكالوريوس علوم فيزياء ٢٠٠٩

إشراف

أ. د. تحسين حسين مبارك

م. د. نمير فاضل غائب

١٤٤٠ هـ

٢٠١٩ م

الخلاصـــة

إن التغذية الممغنطة لها تأثيرات على تجديد كثافة العظام وعلى التئام العظم ومقدار هذا التأثير يعتمد على قوة وتردد المجال الكهرومغناطيسي. خواص التغذية تتغير عند تعرضها إلى المجالات المغناطيسية بحيث تتغير خواص محتوياتها من المعادن والمواد العضوية. المجالات المغناطيسية يسهل عليها اختراق جدار الخلية وتزيد من سرعة الانتشار وتجديد العظام.

هذه التجربة استخدمت لتبين تأثير التغذية الممغنطة على كثافة وتجديد العظام في الفئران وتأثير المجالات الكهرومغناطيسية على شفاء الكسور.

استخدم ٨٠ فأر ابيض في هذه التجربة ،تم تحضير التغذية الممغنطة بواسطة منظومة مكونة من أنبوب حديدي ملفوف حوله سلك عدد لفاته ٧٠٠٠ لفة ومزود بمصدر للتيار المستمر عند فرق جهد ٢٢٠ فولت.

استخدم في التجربة جهازGauss meter لقياس التدفق المغناطيسي، وتم استخدم تقنية DXA SCAN " " التي تستعمل لقياس الكثافة المعدنية للعظام "BMD"، المحتوى المعدني للعظام " BMC"، T-score و Z-score، واستخدم جهاز الاشعة dental X-ray machine لتقدير التئام الكسر.

أجريت المقارنة بين المجاميع من حيث كثافة معادن العظام، المحتوى المعدني للعظام ، T-score و Z-score. وقد استنتج أن بعد ٢١ يوم من الاستهلاك المستمر للتغذية الممغنطة يؤدي إلى تكثيف تجديد وبناء العظام. إضافة إلى ذلك تم الحصول على شفاء للعظام المتعرضة للكسر بعد ١٤ يوم.

وتم استخدام التحليل الاحصائي SPSS لتحليل البيانات، وأظهر التحليل ان النتائج كانت عالية المعنوية وفق اختبار توكي.

الكلمات المفتاحية:- المجال الكهرومغناطيسي ، مقياس كثافة العظام في الجرذان ،هشاشة العظام ،تجديد العظام.