Chemiluminescence study of the effects of Router radiation on red blood cell volume and Erythrocyte sedimentation rate in Human blood human blood

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Abstract. It is in vitro study to examine the effect of electromagnetic radiation from router on human blood samples rheological factors, such as mean red blood cell volume (MCV) and erythrocyte sedimentation rate (ESR). Samples were irradiated for one, ten, twenty four hour, and three with 500 milli-watt. The measurements were done directly after the irradiation, chemiluminescence (CL) signal. MCV and ESR decreased after irradiation for ten hours by 20.6\%, 0.41\% and 5.3\% respectively. This because the effect of radiation on the composition of the plasma that finally effect in ESR of whole blood.

Keyword: Chemiluminescence; MCV; erythrocyte sedimentation rate ESR; Radiation; Router.

1. Introduction

Many scientists have been investigated the influence of electromagnetic waves and related filed radiating from routers. Routers radiate at 2.4GHZ frequency itself belong to range of microwave.

All kinds of radiations carry an energy, so electromagnetic radiation with long wavelength, has low energy which is not able to make atoms’ ionization or chemical bonds changing. Low level energy of radiations, including a microwave has been mentioned by prospective studies, particularly in communications.

It has been proven the increasing exposure to radiofrequency (RF) of electromagnetic field (EMF) has a potential effect on human body[1]. It causing genetics, chromosomal blood, and immune changes[2]. Many studies have explained the relation between microwave radiation and generation of free radicals which effect on the biological functions of living cells [3][4]. Furthermore, It has been described via serval investigators that in vitro bio-stimulation depends on several factors, in addition to parameters of radiation such as , dose, wavelength, output power, beam area[5], and the kind of the exposed tissue[6]. Other studies estimate the histological changes in some organs like testis, kidney and liver[7].

Technological innovations with physics principles have been used recently to reduce the effect of radiation on human blood[8]. The rheological properties of blood are modified when it’s irradiated with power less than 100 mW[9]. One of the essential rheological parameters human blood is erythrocyte sedimentation rate(ESR).It is varied depending on biological, technical, and physical
factors[10], the other parameter that could effected by RF radiation of human blood is mean cell volume (MCV) [11]. Therefore, to report these issues, the measurement of chmiluminescence (CL) intensity in biological components, including blood found the chemical and physical impacts, It was shown that increasing free radical of blood components under the radiation influence causing increase the CL intensity[12].

In this study, an experiential clarification has been done to prove microwaves changes on the human blood rheological parameters like MCV and ESR, and showing the relation between the CL intensity and human blood rheological factors. MCV and ESR parameters have directly related to the measurement of CL intensity because there is a linear dependence between CL intensity and RBC concentration[13].

2. Methods and Materials

Sample preparations

This prospective study was performed in blood central bank at Al-Hussein Teaching Hospital in Samawah City, Al-Muthanna Governorate; Iraq. Blood samples were collected from healthy men with 25 years old. Informed consent prior the procedure has taken from all participants. This study was approved by Ethics and Research committee of Al Muthanna University. Samples were divided into four main groups one of them is non irradiated (control) the others are irradiated with different intervals of time. All samples were kept in a tubes containing ethylene demine tetra acetic acid (EDTA) as an anti-coagulant at 25°C as a lab temperature.

The irradiated blood samples were exposed by router type (Tp-LINK-IC66) (450Mps) with a power of 500 Mw and frequency 2.4 GHZ at the distance 30 cm between blood test tube and the router, The provided doses used for exposed groups of irradiation time were 1 hour, 10 hours, 24 hours, and 3 days.

Parameters’ measurements

Blood parameters MCV and ESR were measured. Mean cell volume (MCV) of all blood samples’ groups (control and irradiated) were measured. An average data of three repeated measurements were performed by using computerized hematology analyzer (3200 BC). Meanwhile the measurement of ESR level were evaluated by using Westerner method[14].

Then CL intensity of the irradiated samples for each period of irradiation were measured by using a counter as in figure 1.

![Figure 1: Schematic view to CL apparatus.](image-url)
All the measuring and irradiation processes were done in dark by setting of the optimum experimental conditions. The operating voltage, PH solvent, and temperature conditions were summarized in Table 1.

### Table 1: The optimum condition for CL signal

| Parameters         | Value |
|--------------------|-------|
| Operating Voltage  | 680   |
| Temperature        | 37°C  |
| PH                 | 7.8   |

#### 3. Results:

Significant effects on parameters of irradiated blood by microwaves in comparison with non-irradiated. The MCV and ESR changes as a function of absorbed microwave dose (Router) were shown in Figure 2 and Figure 3, respectively.

Mean cell volume (MCV) is one of the important blood parameters that could be used to identify the blood properties. So it has been found that microwaves directly affect MCV of irradiated blood for different interval of time in compare with non-irradiated

![Figure 2: The effect of increasing time irradiation on MCV of Human blood samples.](image_url)

Erythrocyte sedimentation rate (ESR) is the other blood parameter. It is significantly effected as a function of irradiated dose for different period of time.
Figure 3: The effect of increasing time irradiation on ESR of Human blood samples.

It is clear from measurements the increasing in MCV cause an increase in ESR, this because the change in buoyant force which become less because it proportional to the volume of R.B.C. Also this affect the CL signal because the sedimentation of RBC’s cause increase the density of blood for the dose 1 h and 10 hour, so it acts as scavenger for the CL signal. Chemiluminescence glow curve of lucigenin is shown as in figure 3.

Figure 4: interval of time for counting glow of CL

Where the concentration of lucigenin $3 \times 10^4$ M, PH (7.8), Temperature of solvent $37^\circ C$. Chemiluminescence glow curve data of lucigenin and different red blood cells concentrations, show that RBC’s act as scavenger for CL signal after 12 seconds as in figure 4.
4. Discussion

Several studies have been done to confirm the microwaves radiation effects on cell functions. In particular, it was proven the variations in sedimentation rate depends on the protein concentration. The radius of spherical aggregation is increased by increasing the plasma protein concentration. Aggregation depends on the cells and the surrounding medium, plasma proteins are chains of amino acid of the building blocks of all body cells, when too many plasma proteins fibrinogen or beta globulin adhere to the surface of red blood cells, they are more likely to clump together, these groups of aggregate cells are heavier, so they fall out from plasma more quickly single red blood cells. Therefore, and elevated ESR is a sign of an increasing of plasma proteins in the blood, which could be the same of a number of different disease so the increasing concentration of plasma protein lead to the increase of RBC aggregation and therefore to increase of ESR.

The cause of this increasing is the presence of plasma together with radiation which causes the transformation of fibrinogen protein to fibrin protein and the process cross-linking of some red blood cells protein occurs, this leads to the increase of the weight of molecule and decrease viscosity of the red blood cells which leads to the increase of aggregation and rouleaux formation for thin reason ESR is increased with increasing the absorbed dose.

5. Conclusion:

The presence study shows that ESR (mm/hr) increase with the increasing of the absorbed dose, the same for MCV because of RBC aggregation which is attributed to decreasing viscosity and increasing permeability because of microwave radiation

6. References

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