Study Effect of Electromagnetic Wave Exposure of Radio Frequency in Blood Cells for Interleukin-2 (Il-2) Production Peripheral Culture Blood Mononuclear Cells (PBMC)

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Abstract

The increase in mobile phone users make more people are exposed to radiation of electromagnetic waves of radio frequency (RF).The mobile phone is an electronic device that emits electromagnetic waves in general with the RF 900 MHz and 1800 MHz. The effects of excessive mobile phone use can disrupt the balance of cells in the body. Blood cells are an essential component in the body. Lymphocytes play a role in the body's immune system; one of the lymphocyte cells is T cells thatproduce cytokines from interleukin-2 (IL-2) which function as regulators of activation, growth,and differentiation of lymphocyte cells and immune mediators in the inflammatory process. This research aims to determine the effect of exposure to RF electromagnetic waves against the production of IL-2 by using a type of RF transmitter VSG25A. The measurement of IL-2 production was carried out with two RF 900 MHz and 1800 MHz with distances from 0 cm to 25 cm and 15, 30, 45, and 60 minutes for each sample. The results showed that exposure to 900 MHz and 1800 MHzRF electromagnetic waves affected the value of IL-2 production. The production of IL-2 due to exposure to RF electromagnetic waves over a 60-minute exposure time with a 2nd order polynomial curve shows a correlation between the times to IL-2 production. For the relationship of distance to IL-2 production it cannot yet be concluded.

Keywords*:* *Electromagnetic Waves, Radio Frequency, VSG25A, Interleukin-2 Production.*

I. INTRODUCTION

As the development of technology, the living cells in the body have a terrible effect. Exposure to radiation of electromagnetic waves must watch out because it effects.Examples of electromagnetic waves that encountered daily are radio waves one of which is a mobile phone. The frequency of the mobile telephone system that commonly used is the Global System for Mobile Communications (GSM) 900 MHz and 1800 MHz[1].

The effects of electromagnetic waves depending on the type, frequency, and duration of exposure. Health problems that will arise as a result of electromagnetic fields can occur from various body systems, one of which is the blood system[2].

The research that has carried out relates to the effect of the emission of cell phone radiation using a type of cellphone (Dual band EGSM 900/1800 MHz) for 1 hour exposure and with a distance of 1 cm, the result is an increase in the number of red blood cells, a decrease in the number of white blood cells and the amount lymphocytes [3].

Lymphocytes are a type of leukocytes that a role in the body's immune system. Cells of lymphocytes are T cells that function as the cells that regulate the immune response by recognizing and activating other lymphocytes. T cells produce cytokines which these cells if disturbed, will affect the balance of cell production in the body [4].

Regulatory T cells have a vital role in the body's sophisticated systems, such as aspects of the immune and autoimmune responses. Regulator cells express CD25, which is the receptor for interleukin-2 (IL-2), the development and function depend on the expression of key transcription factors, transcription factor forkheadbox P3 (FoxP3). CD4 + cells are more important to produce IL-2 which has a function to promote T cell activation and increase production[4].

IL-2 is known as a function of T cell growth factors. Th1 cells produce IL-2 required for the expression of the IL-2 receptor on the cell surface of T lymphocytes. Increases and decreases of CD4 +

cells indicate an imbalance of cell conditions that also affect the production of IL-2 to determine its effect on the status of cells in the body, so further research is conducted on the trendline to determine the effect of IL-2 production in the body.

II. MATERIALS METHODS

In this experiment, the donor blood sample as much as ± 25 people, with the genders male and female, age range 18-35 years, and blood was taken for each donor ± 12 cc.

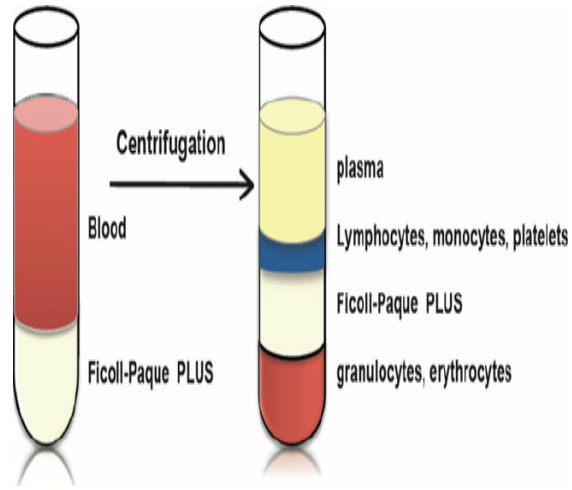
Samples of blood cells as much as 12 ml of culture media were given a mixture which is then done the isolation and culture of PBMCs.Isolation cells is a process of separation of molecules from other molecules in the cell whilePBMC cultures are processes where only cells that have a single nucleus (lymphocytes and monocytes) are isolated.

Control blood group was given anti-collagen from being damaged when it is outside the body condition to use as a comparison with the blood of the treated group (exposure GEM).

Blood in EDTA vacutainer sample to tested inverted turning slowly so homogenized and then mixed 1:1 with PBS and then taken with a micropipette on the tube that has filled with Ficoll-Hipaque 1,077. Comparison between the Ficoll-Hypaque volume blood samples is 1:1. So that will be formed two layers and then centrifuged at room temperature and speed of 1000 rpm for 30 minutes.

After being centrifuged, it will separate into five layers, is plasma, PBMC, Ficoll-Hipaque, granulocytes,and erythrocytes (RBCs) (Fig 1). The PBMC ring formed is taken slowly using a micropipette and placed in a new 15 ml centrifuge tube. PBMC isolation was then washed with 10 ml PBS and centrifuged at room temperature at 1200 rpm for 10 minutes. Erythrocyte contamination added by RBC lysis buffer. The supernatant removed,and the formed pellets were rewashed with PBS and centrifuged again at room temperature of 1200 rpm (1000-1600 rpm) for 10 minutes and carried out twice. After being centrifuged, pellets (PBMC cells) will form at the base of the 15 ml centrifuge tube.

Fig 1: PBMC isolation



The treatment is then carried out to be given exposure to radio frequency electromagnetic waves with two frequencies, 900 MHz and 1800 MHz RF using a VSG25A type radio frequency transmitter. The distance for the 900 MHz RF using distance 0 cm; 2.5 cm; and 5 cm whereas for 1800 MHz RF using the square of the distance from the 900 MHz RF among well plate with the blood of the transmitting antenna radiofrequency.Exposure times used were 15 minutes, 30 minutes, 45 minutes and 60 minutes.

The laptop is connected with radio frequency transmitter to adjust the frequency used. Then put the samples in the artificial box for giving exposure to the frequency, distance, and time determined (Fig 2).

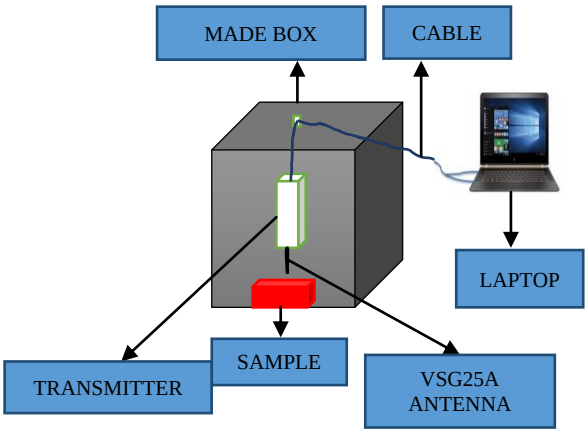


Fig 2:Exposure scheme RFelectromagnetic waves

After the exposure process and then doharvesting and stunning for 48 hours. Then after that process, a sample placed in an incubator at a normal temperature. And reagents were given to determine the number of CD4 and IL-2 cells in lymphocytes after being treated and read using flow-cytometry.

The research result calculated to obtain the average and standard error of the mean. Calculations to determine the percentage change in IL-2 production:

$$x = \frac{B}{A} \times 100\%$$

Description:

x = comparison of the percentage of IL-2 production

B = amount of IL-2 production after exposure

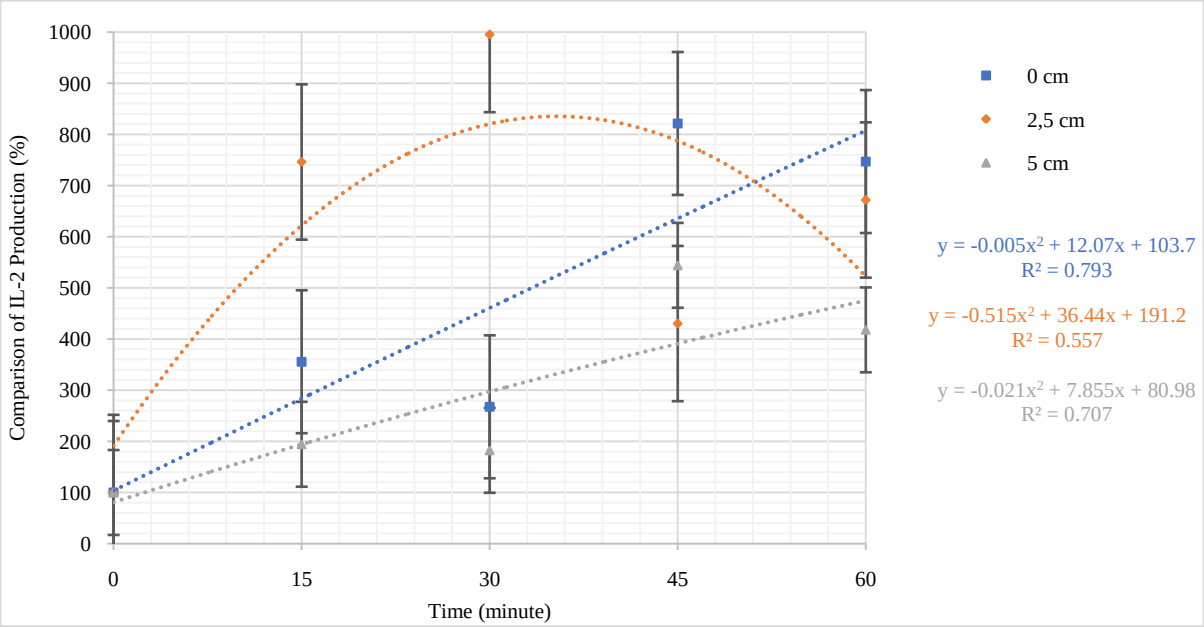
A = amount of IL-2 production before exposure

III.RESULTS AND DISCUSSION

Based the research that has been done, it obtained a graph of the relationshipbetween percentagecomparison of IL-2 productionandradiofrequency exposure time with 900 MHz (Fig 3) and 1800 MHz (Fig 4).

Based on Figure 3 shows the relationship of time to the comparison of IL-2 production with 900 MHz RF.The results of the research canthat the tipping point for a distance of 0 cm obtained at the time of 45 minutes, whereas for a distance of 2.5 cm cusp obtained at 30 minutes and for a distance of 5 cmobtained peak on 45 minutes.

Fig 3: The relationship between percentagecomparison of IL-2 production and radiofrequency exposure time with 900 MHz



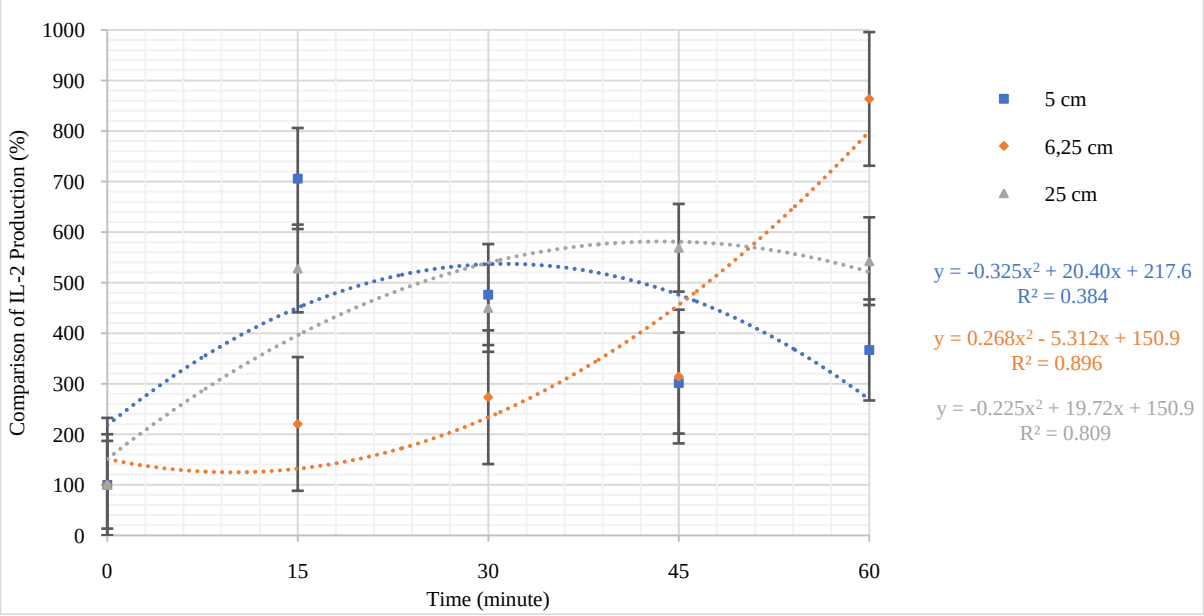


Fig 4: The relationship between percentagecomparison of IL-2 productionand radiofrequency exposure time with 900 MHz

Figure 4 shows the relationship of time to the comparison of IL-2 production with 1800 MHz RF. The results of the research can that the tipping point for a distance of 5 cm is obtained at the time of 15 minutes, whereas for a distance of 6.25 cm obtained peak on 60 minutes and for a distance of 25 cm obtained maximum on 45 minutes.

Based on research that has been done can be said that the longer the exposure time affects the value of the production of IL-2. Effect of time of exposure to IL-2 production value indicated by the decline in value of a given length of time exposure. Decreasing the amount of IL-2 production at a particular time and distance caused by using blood samples from different people, so the amount of lymphocytes before the exposure is also different, even though they are still in the average category. Another thing that influenced the temperature data collection, among others, used at the time of exposure is not constant; the sample used is limited, and the influence of the surrounding environment.

From the research that has been done at a certain time and distance the value of IL-2 production has decreased, this isbecause IL-2 production has been repaired and will be produced to prevent infection and restore network functions as before. Another thing that affects the production of IL-2 reduced because the cells cannot respond to IL-2, so that the T cells can differentiate and then not come back in a resting state, to express the IL-2 receptor again with new stimuli. While increased production of IL-2 as a result of T or B lymphocyte stimulation by an antigen.

In general, cells communication in the immune system involves interleukin which is used for the proliferation and differentiation of hematopoietic cells and regulates and determines immune responses[6], [7]. Interleukin used as mediator interleukin interacting between themselves,and these interactions canin a synergistic or antagonistic.

T lymphocytes that are activated by antigens and can bindto receptors with high affinity on the target cell membrane can Interleukin-2 produced [8].

The critical role of interleukin is in determining the type of the body's immune response that is effective against the infectious agent. To kill intracellular germs, the interleukin will activate macrophages efficiently[9].

In an in-vitro study using polyclonal B cells activated by T cells, it said that IL-2 has a significant role in stimulating the formation of immunoglobulins. The purpose of IL-2 as a growth factor for all subpopulations of T lymphocyte cells and has responsibility for the clonal expansion of T lymphocytes, after T lymphocytes recognize antigens[10], [11].

Therefore, it said IL-2 knowned as a T cell growth factor. IL-2 also has another function that stimulates proliferation of B-lymphocytes to produce antibodies. The role of IL-2 to regulate the balance of lymphocytes that have been active in lymphocytes that have been active for more sensitive to the presence of apoptosis in the presence of IL-2.

IV. CONCLUSIONS

Based on the research that has been done, it can be concluded:Exposure to 900 MHz and 1800 MHz radio frequency electromagnetic waves affects the value of IL-2 production.Production of IL-2 as a result of exposure to radiofrequency electromagnetic waves towards the long exposure time of 60 minutes using the polynomial curve of order 2 shows that the correlation between the time of the production of IL-2while the relationship of distance to IL-2 production cannot yet be concluded.

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