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ELECTROMAGNETIC RADIATION OF EXTREMELY LOW FREQUENCY (ELF)

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ABSTRACT

The spectrum emitted by electromagnetic wave radiation has various frequencies, one of which is Extremely Low Frequency (ELF), and is often found in educational environments, originating from various electronic devices, high voltage electrical panels, and internet network supporting devices. Based on this description, it is necessary to measure ELF electromagnetic radiation in the Faculty of Mathematics and Natural Sciences environment at Universitas Negeri Gorontalo. This research was carried out by measuring magnetic field values (μT) at 42 location points using a Portable Electromagnetic Field Tester (EMF Tester). The research results show that all of these location points are within the safe threshold based on ICNIRP and WHO regulations, namely below 200 μT, with the highest ELF magnetic field value is 2.81 μT, and the lowest ELF magnetic field value is 0.003 μT. However, there are several studies showing that exposure to ELF electromagnetic field radiation can produce free radicals, causing cell damage. The results of this research can be used as a basis for making health policies for the Faculty of Mathematics and Natural Sciences academic community at Universitas Negeri Gorontalo.

Keyword: radiation; electromagnetic; ELF

INTRODUCTION

Electromagnetic waves consist of an electric field and a magnetic field (Qumairoh, Sudarti & Prihandono, 2021), which insulate each other and carry energy from one place to another (Yuniarta, Sudarti & Anggraeni, 2022). Electromagnetic waves do not require an intermediary medium for their propagation (Qumairoh, Sudarti & Prihandono, 2021). Sources of electromagnetic waves consist of natural and artificial. Sources of natural electromagnetic waves are in the form of the electromagnetic spectrum such as gamma rays, X-rays, ultraviolet, visible light, infrared, radio waves and microwaves. Sources of artificial electromagnetic waves are a cable system and electrical energy equipment (Iswardani, Sudarti & Yushardi, 2023).

When there is an electric current flowing, every electronic device can produce a magnetic field. The use of electronic equipment has an important role in increasing the electric field and intensity of exposure to magnetic fields in the environment (Qumairoh, Sudarti & Prihandono, 2021). The electric field has the characteristic of being obstructed, that is, the intensity of the electric field decreases if it is blocked by an object, while the magnetic field has the characteristic of not being easily obstructed and being able to penetrate

objects easily. The energy of the magnetic field is very small so that the effect it causes is a non-thermal effect, that is, it does not cause a change in temperature when interacting or inducing it (Wati, Ferdianti & Sudarti, 2023).

The spectrum emitted by electromagnetic wave radiation has various frequencies, one of which is Extremely Low Frequency (ELF) (Yuniarta, Sudarti & Anggraeni, 2022). ELF electromagnetic waves have a frequency of 0-300 Hz (Qumairoh, Sudarti & Prihandono, 2021). It is included in non-ionizing radiation, because it has a low frequency wave spectrum (Ramadhani, Sudarti & Prihandono, 2022), and are often found in modern society today, especially in educational environments (Olorunsola, et. al., 2021). Facilities and infrastructure to support the learning process come from various electronic devices, high voltage electrical panels, and internet network support devices, which play a role in producing electromagnetic field radiation (Wismaya & Sugianto, 2022).

The normal limit of electromagnetic radiation received by the human body can be tolerated if it comes from electronic equipment in everyday life. However, exposure to electromagnetic radiation continuously and exceeding the threshold can also have a negative impact on human health (Utoyo, Azmi & Sudarti, 2023).

Previous research reported that there was an effect of exposure to ELF magnetic fields with intensities of 150 μT, 300 μT, and 450 μT on brain density in white mice. For a magnetic field with an intensity of 150 μT, the brain density was 1.895 gr, whereas for the experimental group with an intensity of 300 μT there was a slight decrease in the brain density value, namely 1.806 gr, and for the experimental group with an intensity of 450 μT there was also a decrease in the value for the brain density, namely 1.695 gr (Khoiriyah & Sudarti, 2022).

Adult male rats exposed to an ELF magnetic field with a frequency of 50 Hz for 18 weeks without stopping showed a decrease in sperm count and testosterone hormone levels, resulting in a decrease in the rats' fertility levels. Pig uterine tissue exposed to an ELF magnetic field with a frequency of 50-120 Hz for 4 hours can cause changes in the synthesis and release of estradiol-17β in the tissue (Utoyo, Azmi & Sudarti, 2023). The ELF magnetic field can also cause changes in respiratory frequency, pulse rate, blood pressure and leukocytes (Sulistiyowati, Ulfah & Sudarti, 2023).

Universitas Negeri Gorontalo is a university that has experienced rapid development in recent years. Especially in the Faculty of Mathematics and Natural Sciences Campus 4 environment, facilities and infrastructure were built to improve the quality of learning and research, which uses electrical equipment and resources, thus contributing to producing radiation in the campus environment. Based on this description, it is necessary to measure ELF electromagnetic radiation as scientific information that can be useful as a basis for making health policies for the Faculty of Mathematics and Natural Sciencesacademic community, Universitas Negeri Gorontalo.

METHODS

This research was carried out by measuring the magnetic field value (μT) in

the Faculty of Mathematics and Natural Sciences environment at Universitas Negeri Gorontalo. Measurements were carried out at 42 location points spread across Faculty of Mathematics and Natural Sciences, Universitas Negeri Gorontalo. Measurements at each location point were repeated three times. The tool used in this research is a Portable Electromagnetic Field Tester (EMF Tester).

RESULTS AND DISCUSSION

The results of measurements of ELF electromagnetic radiation which have been carried out at 42 location points within the Faculty of Mathematics and Natural Sciences environment at Universitas Negeri Gorontalo, show that at 42 location points it is within the safe threshold based on ICNIRP and WHO regulations, namely below 200 µT. Figure 1 is a graph of the results of ELF electromagnetic radiation measurements that have been carried out.

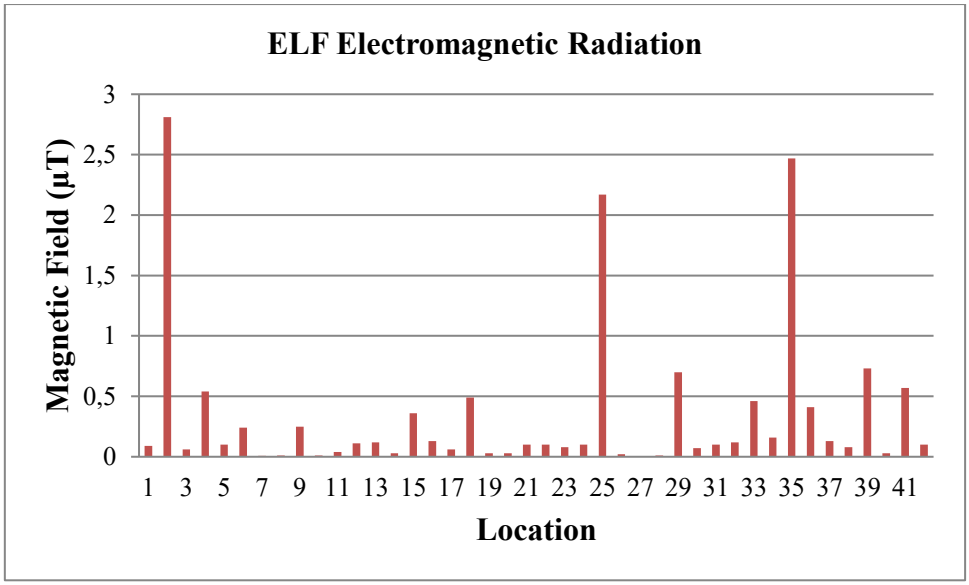

Figure 1. ELF Electromagnetic Radiation Measurement Results at 42 Location Points

Figure 1 shows that the highest ELF magnetic field value is at location point 2, namely 2.81 µT. The location point is on the 1st floor in front of the Physics Department room, where there is a panel builder, which is a device that functions to divide, channel and distribute electrical power from the source or center of electricity to the user, thereby producing the highest ELF magnetic field radiation among all location points. The lowest ELF magnetic field value is at location point 27, namely 0.003 µT. The location point is in the Advanced Physics Laboratory. These values are very far from the safe threshold based on ICNIRP and WHO regulations, so it can be said that the location is safe from ELF magnetic field radiation.

Although the energy produced by ELF magnetic field radiation is low and not enough to cause damage to cells directly, there are secondary effects that can be caused indirectly, namely DNA damage that arises due to the presence of free radicals produced by the interaction of radiation with cells.

Based on previous research, exposure to an ELF magnetic field with an intensity of ≥ 0.4 µT can double the risk of blood

cancer or leukemia in children. Past exposure to ELF magnetic fields may increase the risk of developing brain tumors. In addition, exposure to ELF magnetic fields can also increase the risk of breast cancer, even in women who have not experienced menopause. ELF magnetic fields can be generated by computers or laptops, which can potentially reduce sperm motility and increase DNA fragmentation in sperm (Utoyo, Azmi & Sudarti, 2023).

CONCLUSION

Measurements of ELF electromagnetic field radiation in the Faculty of Mathematics and Natural Sciences environment at Universitas Negeri Gorontalo are within safe limits based on ICNIRP and WHO regulations. However, there are several studies that show that exposure to ELF electromagnetic field radiation can produce free radicals, causing cell damage. This research has produced useful information as a basis for making health policies for the Faculty of Mathematics and Natural Sciences academic community at Universitas Negeri Gorontalo.

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