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Utilization of Extremely Low Frequency (ELF) Magnetic Field is as Alternative Sterilization of *Salmonella typhimurium* In Gado-Gado

Sudarti*

Physics Education Jember University, Jl. Kalimantan I FKIP Universitas Jember 68121, Indonesia

Abstract

Extremely Low Frequency Magnetic Field (ELF-MF) is non-ionizing and non-termal radiation. The previous research result was proven that prevalence death of *Salmonella typhimurium* in the fisiology liquid that has positive correlation with exposure intensity, but without exposure duration. The exposure of ELF 646.7 μT magnetic field during 30 minutes gives higher *Salmonella* death impact rather than 60 minutes and 90 minutes exposure. The objective of this research was to determine dose effectiveness of ELF magnetic field exposure in Gado-Gado fresh food as sterilization alternative method from Salmonella *typhimurium*. The sample in this research was Gado-Gado (containing of seasoning and vegetables) which was gotten from the street vendors around Jember University campus. The dose of ELF magnetic field exposure that be tested was on 646.7μT with exposure during 30 minutes. The dose effectiveness of Extremely Low Frequency (ELF) magnetic field with 646.7μT intensity during 30 minutes was proven can decrease *Salmonella typhimurium* population in Gado-Gado by inhibition effectiveness was shown by the destruction percentage in Gado-Gado seasoning was 56% and in Gado-Gado vegetables was 17 %. According to the result of this research, it could be concluded that ELF magnetic field radiation has potency as the sterilization alternative method of fresh food which was cheap and safe from *Salmonella typhimurium*.

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Keywords: non ionizing radiation, extremely low frequency, magnetic field, *Salmonella typhimurium*.

1. Introduction

Infectious diseases problem, especially typhoid fever still becomes a global health problem for community of the world. Indonesia is one of the typhoid endemic regions with the majority of incidence occurred in the age group 3-19 years approximately 91% of cases (Lesser & Samuel, 2005; Brusch, 2010; IDAI, 2008). This disease is caused by

* Corresponding author.
E-mail address: dr.sudarti_unej@yahoo.com

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Salmonella typhimurium bacteria in the body. *Salmonella typhimurium* transmission mainly occurs through contaminated food or drink. Based on the Indonesian National Standard (SNI), the prevalence of *Salmonella typhimurium* is not allowed in foodstuffs, which means that the test result should show negative value.

Generally, the method done to leave some biological contaminants out including bacteria in foods or beverages is through either radiation of gamma or beta rays. Remaining of the radiation ingredients contained in food or drink would affect biological way in our bodies, which is likely to cause mutation in cells and cause of cancer in the body. While pasteurization process often has an impact on texture change and food taste. Therefore we need a method that is effective, cheap, easy, and safe for the body, and does not change the texture and flavor of food to avoid *Salmonella typhimurium* contamination. Extremely Low Frequency (ELF) magnetic field radiation is a non-ionizing radiation that is easy and inexpensive to obtain and safe for health, at certain dose it can kill cell or bacteria.

The results of previous study, prove that the exposure of ELF 646.7 μT magnetic field during 30 minutes gives higher *Salmonella* death impact rather than 60 minutes and 90 minutes exposure (Sudarti, 2014). Thus, the objective of this research was to determine the exposure dose of ELF 646.7 μT magnetic field during 30 minutes give an effective effect in killing *Salmonella typhimurium* in Gado-Gado.

2. Methods

2.1. Research Design

This research was done on Gado-Gado sample which was gotten from the stree vendors around Jember University campus divided into two groups, namely control group (K), experimental group exposed (ELF) magnetic field with 646.7μT intensity during 30 minutes.

2.2. Tools and Ingredients

The tools used in this research included Magnetic Field Sources, microscopes, incubators, autoclaves, pH-meters, and a set of glass tools. The main ingredient used was Gado-Gado seasoning. The solvent used was distilled water. The bacteria culture test used was *Salmonella typhimurium*. The media used was trypticase soy broth (TSB) dan salmonella chromogenic agar (SCA). Other ingredient used in this research was like NaCl and safranin.

2.3. Experiment Design

The design of the study was the Control Group Design. The sample of this research was Gado-Gado ingredients consisting of seasoning and vegetables gotten from the street vendors around Jember University campus.

3. Result and Discussion

The intensity of magnetic field used in this research is to kill *Salmonella typhimurium* pathogen microbe contained in Gado-Gado ingredients. ELF magnetic field exposure intensity produced by ELF Magnetic Sources tool in FKIP Advanced Physics Laboratory, Jember University, by arranging the electrical current at the tool as presented in Table 1.

Table 1 ELF-MF intensity for *Salmonella typhimurium* destruction

Electrical current (Ampere)	Magnetic field intensity (μT)
500	409.7
700	536.3
900	646.7

The prevalence analysis of *S. typhimurium* in the Gado-Gado was based on the death percentage of *Salmonella typhimurium* calculated based on bacteriological analytical mannual calculation (BAM, 2001), determining the size of bacteria cell (Pelczar and Chan, 1986; Fardiaz, 1989) and acid degree (Dufour et al., 2002).

The prevalence of *S.* typhimurium in Gado-Gado of the control group. Gado-Gado sampel (seasoning and vegetables) was gotten from the street vendors around Jember University campus. The sample gotten was calculated the first exposure *Salmonella* sp. population either in the seasoning or in the vegetables of Gado-Gado. The calculation was done on serial dilution of 100 dan 101. The presence of *Salmonella* sp bacteria on fertilization by using *Salmonella* chromogenic agar media showed by purple or magenta colonies, as shown in Picture 2 for sample of Gado-Gado ingredients and Picture 3 for sample of Gado-Gado seasoning.

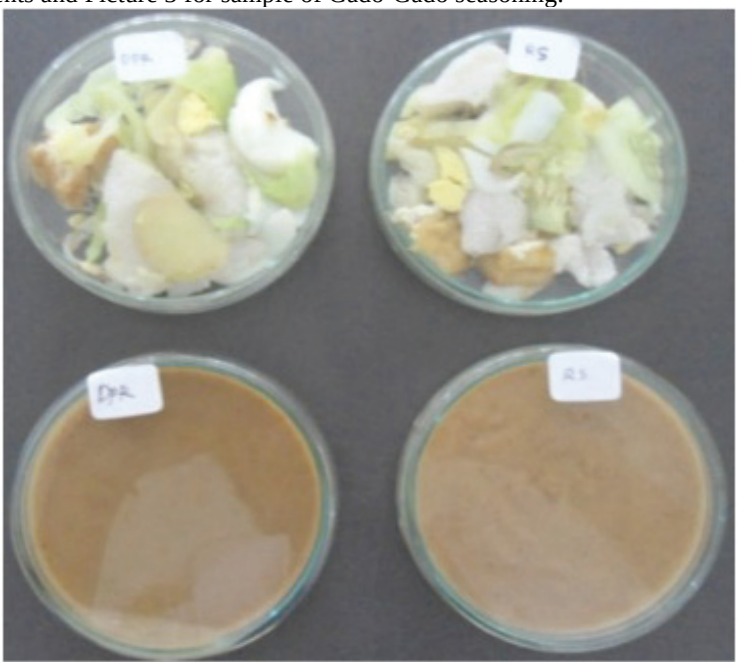

Figure 1. Sampel of Gado-gado (seasoning and vegetables).

The calculation showed that the Gado-Gado samples either the sauce and the ingredients contained of *Salmonella* sp. bacteria was 2 log cfu/ml (more than 100 colonies per ml) at the ingredients of Gado-Gado was 1 log cfu/ml (approximately 10 colonies per ml). The population was not suitable with Indonesia National Standard (SNI 1992 dan SNI No 01. 6242. 2000) for drinking water and ready consumption food (ready to eat/RTE) that the presence of *Salmonella* sp bacteria should be zero (none) in the ready consumption food.

The population of *Salmonella* sp. bacteria was quite high in the Gado-Gado vegetables ingredient because there were food variety such as egg, cabbage, bean sprouts, lontong, potatoes, cucumber, tofu, etc. which majority of those consist of row ingredients and commonly were at room temperature in a long time. Eggs are the largest opportunities to be contaminated by *Salmonella* sp. bacteria. Lavigne and Blanc-Potard (2008) reported that the eggs are often contaminated by *Salmonella enterica* serovar *typhimurium*. Besides, it was also very possible to be occurred the cross-contamination of fresh food contaminated by *Salmonella* bacteria and coliform or equipment and presentation by the seller.

Vegetables ingredient sample of Gado-Gado of each cup containing 100g of the group exposed to ELF magnetic fields 646,7μT intensity for 30 minutes and the control group was not exposed to vegetable ingredient that ELF magnetic field.

Seasoning sample of Gado-Gado in the cup containing of a group 100g exposed by ELF magnetic field with 646.7μT intensity during 30 minutes and the control group was not exposed by ELF magnetic field.

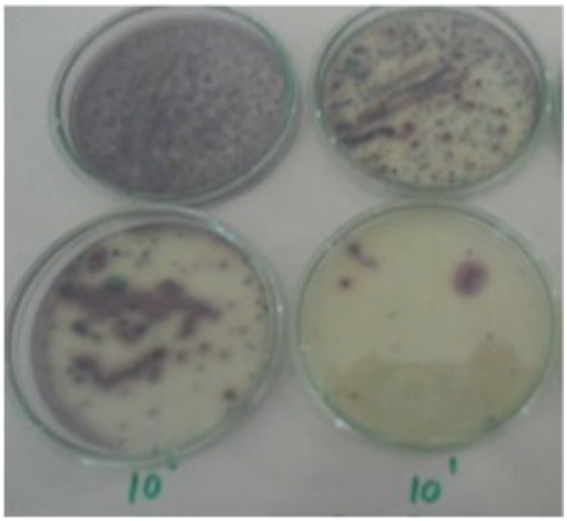

Figure 2. *Salmonella* sp. population on Gado-Gado vegetables before (top) and after (bottom) exposed by ELF magnetic field.

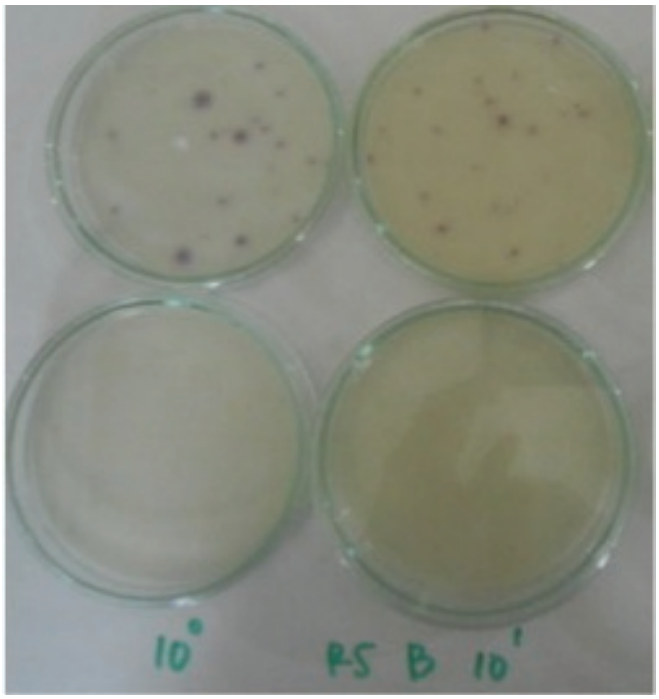

Figure 3. *Salmonella* sp. population in Gado-Gado seasoning before (top) and after (bottom) exposed by ELF magnetic field.

The research result showed that there was reduction of *Salmonella* sp bacteria population in Gado-Gado seasoning exposed by ELF magnetic field with 646.7μT intensity during 30 minutes. The biggest destruction percentage occurred in Gado-Gado seasoning that was 56% compared to Gado-Gado vegetables (17%). It occurred because on Gado-Gado ingredients was solid form and in Gado-Gado seasoning was liquid form. Beside that Gado-Gado ingredients contained of protein such as in eggs. Foodstuff containing protein was the strong component protector for bacteria cell to heat treatment as well as physical and mechanical. Gurtler et al. (2010) reported that

Salmonella sp protected by cryoprotectant compounds such as protein and fat will have a better resistance to physical and mechanical treatments.

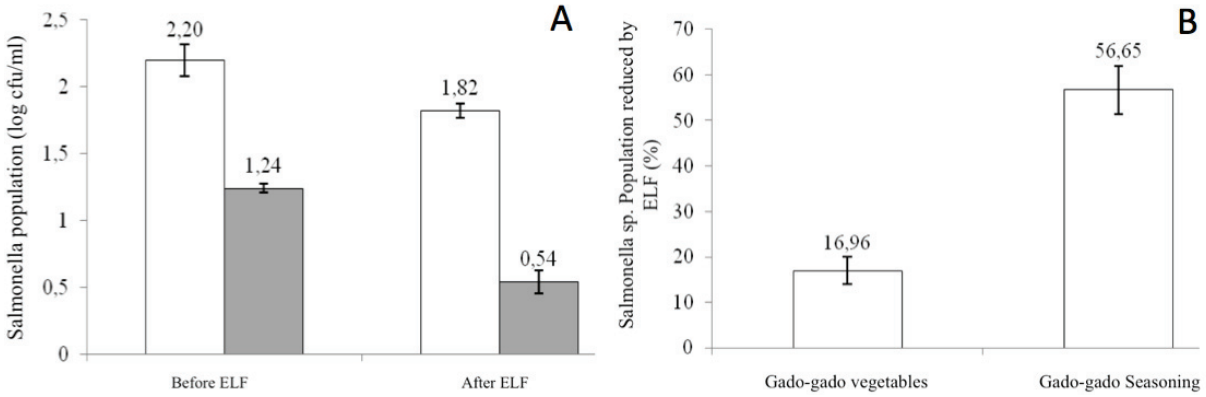

Figure 4. (a) *Salmonella* sp. population after and before ELF treatment with 646.7μT intensity during 30 minutes: on vegetables and seasoning of Gado-Gado (b) fig. 5 *Salmonella* sp. destruction percentage after ELF treatment with 646.7μT intensity during 30 minutes

Consumption of food contaminated by *Salmonella* bacteria could increase the frequency of tropical diseases such as typhus. Indahwati and Jusmaldi (2010) reported that the highest frequency of tropical diseases occurrence caused by typhus by *Salmonella* Typhi (20.73%) compared to tropical tuberculosis disease (1.37%).

4. Conclusion

The dose effectiveness of Extremely Low Frequency (ELF) magnetic field with 646.7μT intensity during 30 minutes was proven can decrease *Salmonella typhimurium* population on Gado-Gado fresh food by inhibition effectiveness was shown by the destruction percentage in Gado-Gado seasoning was 56% compared to the destruction percentage on Gado-Gado vegetables was 17 %. According to the result of this research, it could be concluded that ELF magnetic field radiation has potency as the sterilization alternative method of fresh food which was cheap and safe from Salmonela *typhimurium*.

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