

## A potency of ELF magnetic field utilization to the process of milkfish preservation (*chanos chanos*)

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**Abstract.** This research aims to prove that Extremely Low Frequency (ELF) magnetic field radiation can be used in the process of milkfish preservation. The sampling consists of three groups, the first group is exposed by ELF magnetic field of 750  $\mu$ T, the second group is exposed by ELF magnetic field of 900  $\mu$ T, and these groups are exposed in 2x 30 minutes and 2x 45 minutes. The third group is the control, which does not need to be exposed by the ELF magnetic field. The research finding shows that the ELF magnetic field radiation exposure of 730- $\mu$ T intensity during 2x30 minutes in the fresh milkfish has been proven to reduce bacterial growth up to 73% and the exposure of 880 $\mu$ T ELF magnetic field radiation can reduce the bacterial growth up to 62% in the fifth hour after the exposure than the control. Meanwhile, the ELF magnetic field exposure by the intensity of 730 $\mu$ T or 880 $\mu$ T during 2 x 45 minutes significantly shows the stability of bacteria number than the control. Therefore, the ELF magnetic field radiation in more than 700 $\mu$ T intensity in 2 x 30 minutes has the potential to be applied in the process of milkfish preservation.

### 1. Introduction

Many reports show about the changes in biological systems is caused by ELF (Extremely Low Frequency) magnetic field. The ELF magnetic field is none ionizing electromagnetic waves. The radiation of none ionizing electromagnetic waves will not produce ionizing radiation of molecules [1]. The radiation of none ionizing is defined as a proliferation of energy emission where if it passes a certain media and creates an absorbing process, the energy of radiation will not induce the process of ionization in that media [2]. The principal theory about the biological effect from the magnetic field is based on the permeability effect of the ion channel in a membrane. Accordingly, this condition will affect cell growth that caused biological changes in the organism [3].

Six strain bacteria; three gram-negative and gram-positive is exposed by 50 Hz, 0.5 mT ELF-EMF (Extremely Low Frequency-ElectroMagnetic Field) in 6 hours. The results show there is a decreasing of growth compared to the control sample, which is observed in all strain during ELF-EMF application [4]. The research by Ahmed [5] presents the ELF magnetic field by 0.5 mT-2.5 mT exposure in 90 minutes to reduce the colony-forming unit in the *Staphylococcus Aureus* bacteria. The application of the ELF magnetic field by 1 mT exposure, 50 Hz in 48 hours reduces *P. Aeruginosa*, and *S. Epidermidis* biofilm



around 50% compared to the normal condition [6]. The ELF magnetic exposure by 10 mT intensity, 50 Hz in less than 30 minutes reduces the colony-forming unit of *Escherichia coli*, *Leclercia adecarboxylata* and *Staphylococcus aureus* [7]. The ELF magnetic field mostly used in some sectors, one of them is in the food sector based on the ELF magnetic field effect to activate bacteria. Sudarti [8] illustrates that ELF magnetic field in 646.7  $\mu\text{T}$  intensity by 30 minutes exposing can reduce the population of *Salmonella Typhimurium* in the Gado- Gado's sauce up to 56 %, and 17% in that piece of vegetable. Conversely, magnetic field technology can be applied to activate pathogen microorganisms, which is the reducing of microbe up to 99.45 % in the process of cider preservation.

The high water-based in the fish become a media of the bacteria or microorganism to grow well. Thus, fresh fish will be contaminated shortly. One of the Indonesian favorite fishes is milkfish. Pamijati [9] assumed that milkfish becomes Indonesian favorite fish due to the high nutrition and complete protein that is important for the human body. Milkfish is one of fish contains low fat and high protein so that it becomes the best place for the bacteria to grow. Based on Rafik and Rita's [10] observation, milkfish will decay if it is left around 12 hours at room temperature. The easiness of milkfish decay become the obstacle of people or fish seller in the marketplace. Consequently, there should be a solution to preserve the fish so it can defend the freshness longer. There are many methods or techniques of preservation done to extend the storability of milkfish. It starts from the screening [11], soaking [12], fumigation[13] even using dangerous stuff like formalin. These preservation methods are included in the thermal method where the thermal preservation method can reduce the quality of food.

ELF magnetic field can be used as a media to inhibit a certain microorganism. In a foodstuff, the coming of pathogenic bacteria becomes one of the problems to decay the food shortly. Food generally is easily damaged (perishable), it is caused by the water-based inside that helps the metabolism activities and also simultaneously become a way for infiltrating bacteria to enter. Therefore, the observation entitled A Potency of ELF Magnetic Field to the Process of Milkfish Preservation (*Chanos Chanos*) is done to contribute as one of the solutions in preserving milkfish.

## 2. Method

This research is based on laboratory experiment research. This is conducted in an advanced Physics Laboratory as a place to expose the ELF magnetic field and Microbiology Laboratory of faculty of teacher training and education in the University of Jember as a place to measure the number of bacteria in a milkfish.

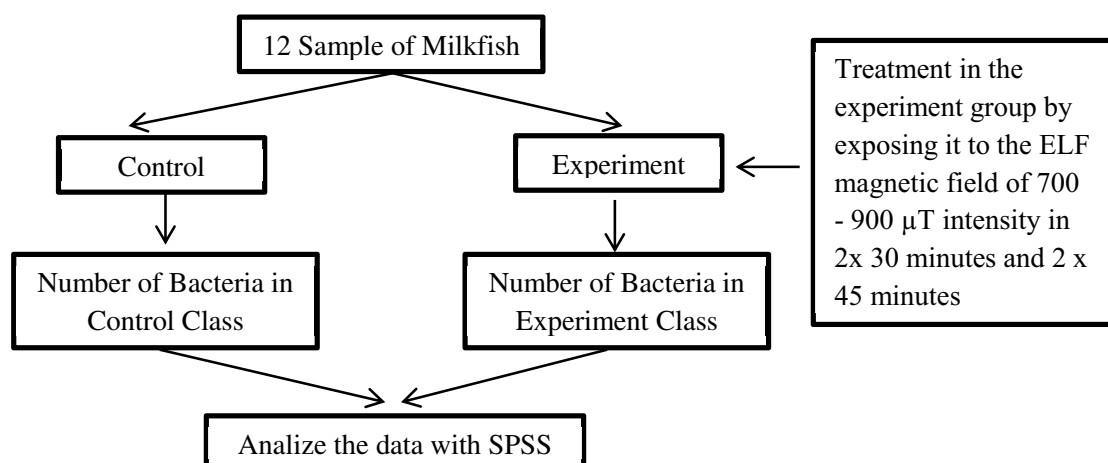


Figure 1. Research Procedure

The procedure of research explained in Figure 1 started by preparing 12 milkfishes as a sample. The milkfishes are divided into two groups, which are the control, and the experiment group. Furthermore, the next steps include measuring the bacterial number in the control group, giving a treatment in the experiment group by exposing it to the ELF magnetic field of 700 - 900  $\mu\text{T}$  intensity in 2x 30 minutes and 2 x 45 minutes, measuring the number of bacteria in both control and experiment groups, analyzing the data, discussing the result of data analysis, making a conclusion based on the research conducted. The bacteria is measured using MCA (Mac Conkey Agar) media and the Total Plate Count method every 06.00, 11.00, 14.00, 17.00 o'clock. The measurement of bacteria is done 5 times for each sample group. This method uses a statistic analysis of One Way ANOVA by SPSS.

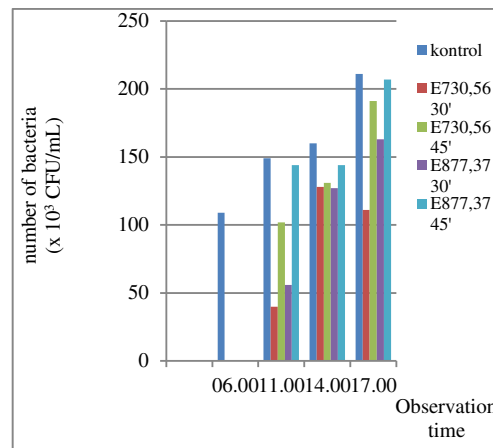
### 3. Result and discussion

The data of bacteria measurement in the milkfish using CFU/ml (Colony Forming Unit) is presented in this table:

**Table 1.** The Data of Bacteria Number

The average of bacterial number CFU/mL (x 105)					
Jam ke	Kontrol	730 $\mu\text{T}$		880 $\mu\text{T}$	
		30'	45'	30'	45'
0	1,09				
5	1,49	0,4	1,02	0,56	1,44
	137%	27%	68%	38%	97%
8	1,60	1,28	1,31	1,27	1,44
	147%	80%	82%	79%	90%
11	2,11	1,11	1,91	1,63	2,07
	194%	53%	90%	77%	98%

Table 1 and Figure 2 show the changes in contaminated bacterial numbers in the milkfish caused by ELF magnetic field. It is clear that, if this is compared to the control, there will present a decreasing of bacterial numbers in the overall groups that are exposed by the magnetic field than the control. Each time of the control class has a bacterial number compared to the other experimental classes. Accordingly, it demonstrates the influence of the ELF magnetic field toward the number of bacteria in the milkfish. E730,56 30' samples have generally least bacterial number in each measurement, where the bacterial number is less than  $1,35 \times 10^5$  CFU/ml (Colony Forming Unit) and remains constant to 17.00 o'clock. However, at 8 o'clock and 11 o'clock, the bacterial number increases in all sample. These points out the recovery mechanism of the bacteria toward the ELF magnetic field effect. The ELF magnetic exposure in the 730  $\mu\text{T}$  and 880  $\mu\text{T}$  intensity in the fresh milkfish significantly can reduce the proliferation of pathogenic bacteria in the fresh milkfish through 2 x 30' exposure.



**Figure 2.** The population of bacteria in the milkfish.

The magnetic field is oscillating to affected different bacterial strains in the lag phase of its growth [7]. The lag phase is a phase where new bacteria adapt toward a new settlement. This phase depends on the media composition, pH, temperature, aeration, the number of cell inoculum and the physiologies character of microorganism. Each bacterial strain has a various response in the intensity, frequency, and the long exposure from the ELF magnetic field [14]. The ELF magnetic field causes the biological changes in cell growth [15], the surface cell characteristic [16]. and the number of RNA transcription also the protein [17]. Followed by that, Gobba and Malagodi [18] stated that the magnetic field acted to the plasma membrane through interaction media that influence enzyme activity and induced signal track. Ione track that passes protein track is affected by electricity potency and chemical source in a membrane cell, which will be influenced since it is placed in electricity areas. The influence of the ELF magnetic field produces bacterial inactivation so that experimental bacteria classes tend to be small in number than the control bacteria class.

The result of the experiment presents there is inhibition in the transposition. Some studies about the effect of ELF magnetic field in transposition declares that the effect of ELF magnetic field generally depends on the physic and biological parameter, included the characteristic of field (frequency, amplitude, waving form, etc), the exposure duration, metabolic cell condition, genotype, as well as the length of cell growth before, during and after the exposure [19]. The various target such as ion, protein DNA complex is assumed also taking part in the interaction of cell and ELF magnetic field. This condition indicates that intensity and exposure also contribute to the number of bacteria and their effectiveness in inhibiting bacterial growth. Otherwise, a commonly experimental sample, which has been exposed by ELF magnetic, can overcome and inhibit the process of invasion (bacterial process to enter a cell or tissue and disperse throughout the body). This condition shows the ELF magnetic field exposure can inhibit bacterial proliferation.

#### 4. Conclusion

Based on the statistical analysis and the discussion, the ELF magnetic field exposure influenced bacterial growth in the milkfish. The result shows that ELF magnetic exposure is proven can reduce the growth of bacteria up to 73%, and the exposure of 880 $\mu$ T in 2 x 30' can reduce the growth of bacteria to 62% at 5 o'clock after exposure compared to the control. Meanwhile, the ELF magnetic exposure in ELF 730 $\mu$ T or 880 $\mu$ T during 2 x 45' do not cause the reducing of bacteria amount significantly than the control.

Therefore, the ELF magnetic field radiation in the lowest intensity of more than 700 $\mu$ T in 2 x 30' has the potency to be applied in the process of fresh fish preservation.

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