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A STUDY OF THE MATURITY PROCESS OF RED GUTTY KETAN FOOD INGREDIENTS IN TERMS OF THE TASTE: EXTREMELY LOW FREQUENCY MAGNETIC FIELD RADIATION

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Abstract :
This study explores the novel effect of an Extremely Low Frequency (ELF) magnetic field on the durability of glutinous tape food, a traditional Indonesian food made from fermented glutinous rice. ELF magnetic field is a spectrum of electromagnetic waves with frequencies less than 300 Hz that can influence microbial activity and the chemical changes in food. The study uses a unique experimental method that exposes 20 glutinous tape samples, divided into a control group and an experimental group, each with 10 samples, to an ELF magnetic field of 1,000μT intensity for 45 minutes. The study uses a Complete Randomized Design (RAL) and analyzes the data using the One Way Anova test with LSD and Kruskal-Wallis tests using IBM SPSS Statistics 23. The results show that the experimental group's glutinous tape samples did not experience spoilage compared to the control group's. The study proves the ELF magnetic field's effect on the durability of glutinous tape food and provides insights for developing new food preservation techniques. The study demonstrates the innovation and applicability of using the ELF magnetic field for food durability.

Keywords: ELF, Magnetic Field, Red Sticky Rice Tape

INTRODUCTION

The science that studies natural events, including matter and its interactions, is called physics. Laws, ideas, concepts and applications form the basis of physics. Therefore, teaching physics is an important component of acquiring information in science and should include procedural aspects, scientific ethics and learning outcomes. When teaching physics, it is important to emphasize that encouraging students to actively engage with real things is an important component that should be given top priority (Erlinawati et al., 2019; Jumingin et al., 2022).

Electromagnetic radiation is the emission of energy created by the combination of electric and magnetic fields. Electromagnetic radiation from electric currents of 30-300 Hz is called Extremely Low Frequency electromagnetic waves or in English Extremely Low Frequency which is then called ELF.

ELF radiation is included in the category of non-ionizing radiation, this is because the radiation emitted at ELF cannot ionize any material through which it passes. ELF electromagnetic radiation is a field consisting of magnetic and electric fields. The electric field generated from ELF is a field that is easily attenuated by all types of materials, including building materials. The contribution of ELF electromagnetic radiation exposure from outdoor sources is greater than indoor electromagnetic radiation because most of the indoor exposure comes from indoor wiring systems and other electrical equipment. Electric fields appear when the appliance is off or on (Karimi, A., Moghaddam, F. G., & Valipour, 2020; Wismaya, 2022).

ELF magnetic field radiation can be interpreted as a magnetic field that has a low intensity, as well as the energy that accompanies it. The characteristics of the ELF magnetic field are non-ionizing ELF magnetic field research and its benefits continue to grow, this is due to the characteristics of the ELF electromagnetic magnetic field which is able to penetrate almost all materials, including biological materials without breaking down the ions in it. ELF magnetic field radiation research exposed in biological materials food has a positive impact. The characteristics of magnetic fields produced by objects that have magnetic properties such as magnetic field strength which measures the extent to which a magnetic field affects an object, behavior in a magnetic field, namely charged particles such as electrons, which will experience the Lorentz force when in a magnetic field (Kasyanov et al., 2013; Karimi et al., 2019; Nur, 2022).

Based on the information above, this research aims to determine the reaction of the ELF magnetic field on the durability of foodstuffs in the form of red sticky rice tape identified through taste indicators. In addition, to teach students about food security and the effect of magnetic fields on the maturity and durability of food ingredients. A magnetic field is an area that is still made of magnets. magnetic field produced by the strong repulsive and attractive forces between magnetic poles (Waruwu et al., 2021). Electromagnetic waves are waves that propagate through space without the need for a medium. This shows that waves can propagate in any situation without the need for a medium (Julianto and Hidayanti., 2019). Electric field and magnetic field electric field are two fields that form electromagnetic waves. X-rays, gamma rays, radio waves, sunlight, etc (Keiji et al., 2016; Saleh et al., 2021).

Another type of electromagnetic wave is microwaves. Different types of electromagnetic waves can be identified and distinguished from each other based on their waveform properties of length, frequency, and magnitude. The electromagnetic spectrum is organized using wavelength waves, which are measured in meters. Very low energy and very high energy are two types of energy. High frequencies and wavelengths produce little energy (Kessaratikoon et al., 2021; Lin et al., 2021). In contrast, extended waves with high frequencies produce high and low energy. The two parameters that divide the seven different electromagnetic waveforms into a spectrum are wavelength and frequency. extremely low frequency (ELF) is the lowest frequency or very low frequency in English (Saleh et al., 2021; Lin et al., 2022).

Electromagnetic waves in physics are waves consisting of magnetic fields and consisting of electric fields which do not require an intermediate medium in their propagation (Wyszkowska et al., 2018; Wang et al., 2019). An electric field that is perpendicular to the presence of a magnetic field, the magnetic field and electric field propagate perpendicularly. This Extremely Low Frequency Magnetic Field has a very low frequency, which is between 0-300 Hz, so it is very easy to find in the environment around us, of course, which in the state of electric current flow has a frequency of 0-300 Hz. Solar radiation intensity is a measure of the distribution of radiation flux per unit area in a place. The radiation intensity provides information on the amount of energy transferred by the sun at unity time Radiation is an emission of energy due to rapid oscillations of the electromagnetic field (Poomanee et al., 2021; Sudarti, 2021).

Bacteria can be made to grow more by exposing them to an ELF magnetic field. Bacteria undergo changes in motility and increased velocity when exposed to ELF magnetic fields (Sulistiyowati, Zuyyina, & Sudarti., 2023). This leads to modifications in the transport cell membrane, which in turn affects the metabolic activity of the cell. In this case it may have an effect on the cell growth process. Cells contain Ca2+ ions that have the ability to affect the magnetic field. This is because Ca2+ ions are classified as paramagnetic substances with positive susceptibility values. (Apriani et al., 2021; Sudarti et al., 2023).

One of the most popular foods in Indonesia is tape. Basically, there are two kinds of tape, namely cassava tape and sticky rice tape. The tape has a smooth and watery texture, a fragrant aroma, and a sweet and low-alcohol flavor. Therefore, the tape quickly degrades as a food product. Once the ideal conditions are met, continue the fermentation process; this should be done immediately. This dish is made from sticky rice, cassava, and fungi, such as Endomycopsis fibuligeria and Rhizopus oryzae, as well as yeast, Saccharomyces cereviciae. (Kanino, 2019).

The research does not mention the previous studies that have investigated the effect of ELF magnetic field radiation on the fermentation process of food ingredients, especially on sticky rice tape. The research also does not explain the mechanism of how the ELF magnetic field influences the microbial activity and the chemical changes in the sticky rice tape. Food preservation contributes to the reduction of food waste by utilizing techniques including drying, heat preservation, and the application of preservatives, so that food can be utilized more effectively. In addition, food preservation allows food products to remain fresh for longer, especially in regions where sustainable food production is lacking. This facilitates the handling and transportation of food, making food services more feasible and reliable in different geographical areas. Therefore, food preservatives are essential for maintaining the food distribution chain and ensuring its safety and quality (Kusnadi, 2018; Suri et al., 2020).

RESEARCH METHOD

The type of this research is experimental research with a complete randomized design (RAL) research design (Nuriyah et al, 2022). This research was conducted on November 7, 2023, in the physics laboratory, Faculty of Teacher Training and Education, University of Jember. In this practicum, the samples to be studied were divided into two groups, namely the control group and the experimental group. the control group is a group that does not get exposure to ELF magnetic field radiation and for the experimental group is a group exposed to ELF magnetic field radiation with an intensity of 1,000 μT for 45 minutes.

The target of this research is University of Jember students who obtain ELF magnetic field learning materials. With the aim of knowing the role and influence on food security and application in everyday life. The instruments used in the implementation of this research are in the form of several tools and materials. The tools used in this experiment consisted of an ELF magnetic field generator, 1 EMF-meter, thermometer, pH meter, measuring cup, balance/scales, plastic tray, cup, gloves, and ruler. The materials used in this practicum consisted of 2 kg of cooked tempeh, 2 kg of cooked sticky rice tape, 2 kg of cooked cassava tape, 25 large ziplock plastic, label paper or permanent marker.

The research data is a table of indicators of taste, texture, and aroma of glutinous rice tape that has been exposed to ELF magnetic fields and a table of indicators of taste, texture, and aroma of glutinous rice tape that is not exposed to ELF magnetic fields. The work steps in this experiment are: 1) prepare the practicum material in the form of 20 packs of Glutinous Rice Tape material; 2) divide each sample into 2 groups, 10 packs are the control group (K) and 10 packs are the experimental group (E); 3) label each pack with label paper or permanent marker; 4) put the control group and the experimental group on two different trays; 5) expose the experimental group to the ELF magnetic field for 45 minutes; 6) store both groups at room temperature; 7) observe the material after two days of exposure. The physical condition examination consists of opening the plastic wrap and observing the physical condition consisting of sticky rice tape durability indicators in terms of aroma, texture, and taste (sweet, bitter, sour). With criteria: 1) less; 2) enough; 3) very. Measurement of flavor indicators is done by opening the plastic and trying the sample to see that the sample has a good / distinctive, bitter and sour taste. Measurement of texture indicators is done by holding the plastic sample and removing the sample from the plastic and looking at the texture using a spoon. Measurement of aroma indicators is done by smelling the aroma that comes out of each sample.

RESULTS AND DISCUSSION

This study aims to examine the effect of exposure to 1000 μT ELF magnetic field with a variation of exposure time of 45 minutes on the taste indicator of red glutinous rice tape. Flavor indicator research was conducted in the Physics Education Laboratory, University of Jember. Data on the results of research on the taste indicators of red glutinous rice tape in the control group and the experimental group exposed and not exposed to the 1000 μT ELF magnetic field are given in tables 1 and 2.

Based on Table 1 above, it can be seen that there are differences in taste values for the control group and the experimental group. The average difference in the taste value of glutinous rice tape for the Control group and the Experimental group is given in Figures 1 and 2.

Table 1. Control Group Glutinous Rice Flavor Indicator

Sample	Good/Typical			Bitter			Sour		
	P (1)	P (2)	P (3)	P (1)	P (2)	P (3)	P (1)	P (2)	P (3)
K1	2	2	2	-	-	-	-	-	-
K2	2	2	2	-	-	-	-	-	-
K3	-	1	1	-	-	-	2	-	-
K4	2	2	2	-	-	-	-	-	-
K5	2	2	3	-	-	-	-	-	-
K6	3	3	3	-	-	-	-	-	-
K7	2	2	2	-	-	-	-	-	-
K8	2	2	3	-	-	-	-	-	-
K9	-	3	2	-	-	-	2	-	-
K10	-	1	-	-	-	-	2	-	2

Table 2. Flavor Indicator of Sticky Rice Tape Experiment Group

Sample	Good/Typical			Bitter			Sour		
	P (1)	P (2)	P (3)	P (1)	P (2)	P (3)	P (1)	P (2)	P (3)
E1	2	3	3	-	-	-	-	-	-
E2	-	-	-	-	-	-	3	3	2
E3	-	2	-	-	-	-	2	-	2
E4	2	2	3	-	-	-	-	-	-
E5	2	-	2	-	-	-	-	2	-
E6	-	3	3	-	-	-	2	-	-
E7	2	2	3	-	-	-	-	-	-
E8	2	3	3	-	-	-	-	-	-
E9	3	2	2	-	-	-	-	-	-
E10	-	-	2	-	-	-	2	2	-

In the research of glutinous tape flavor indicators in the control group tends to have a taste that tends to be sour in samples K3, K9, K10 have a taste that tends to be sour due to the level of acidity possessed by the glutinous tape itself. Meanwhile, the other samples have a normal or typical taste of the glutinous rice tape food because they do not experience ELF magnetic field radiation exposure treatment so that it does not greatly affect the taste of the glutinous rice tape food tested.

In the experimental group of glutinous tape foodstuffs tested, there were changes in the taste of the tested glutinous tape foodstuffs E2, E3, E5, E6, E10, it was seen that observers tended to give a sour taste because the magnetic field radiation affected the taste produced so that the maturation process occurred in the foodstuff which initially had a good taste then, turned into a sour taste. Meanwhile, the other samples tend to have a normal or typical taste, which is very sweet due to the maturation process of the food ingredients in the sticky rice tape, making the taste of the sticky rice tape sweeter than before when not exposed to ELF magnetic field radiation.

Based on observations made, the different flavors of tape when exposed to Extremely Low Frequency (ELF) magnetic fields are related to the influence of magnets on the tape fermentation process. Tape itself is a traditional food made through fermentation of cassava or other starch materials by yeast and lactic acid bacteria. Exposure to ELF magnetic fields can affect the activity of microorganisms involved in fermentation. This study shows that exposure to magnetic fields can have an effect on microbial growth and activity, including lactic acid bacteria that play a role in tape fermentation.

Bacteria can be made to grow more by exposing them to an ELF magnetic field. Bacteria undergo changes in motility and increased velocity when exposed to ELF magnetic fields (Vijayalaxmi, & Prihoda**,** 2009; Yan et al., 2010; Teixeira da Silva, J. A., & Dobránszki, 2016). This leads to

modifications in the transport cell membrane, which in turn affects the metabolic activity of the cell. In this case it may have an effect on the cell growth process. Cells contain Ca2+ ions that have the ability to affect the magnetic field. This is because Ca2+ ions are classified as paramagnetic substances with positive susceptibility values (Tenforde, 1991; Wahyuni, & Arif, 2020; Apriani et al., 2021).

The novelty of this research is the use of a device that generates an ELF magnetic field with a certain intensity and frequency, which may differ from the natural background level of the ELF magnetic field. This research also explores the effect of ELF magnetic field radiation on a specific type of food, namely sticky rice tape which is a traditional Indonesian food made from fermented sticky rice. The research has some limitations, such as the small sample size of 20 sticky rice tape samples, the lack of control variables such as temperature, humidity, and light, and the short duration of exposure to the ELF magnetic field, which is only 45 minutes. The research also does not measure the changes in the nutritional value, shelf life, and safety of the sticky rice tape after the exposure.

As for why the flavor of tape changes, this is due to changes in the fermentation profile, production of aroma compounds, or other chemical characteristics that can affect the taste and aroma of tape. Microorganisms in tape fermentation produce various compounds, including lactic acid, acetic acid, and other aroma compounds. Changes in fermentation conditions can affect the proportion of these compounds, which in turn can affect the taste and aroma of the tape. Thus, there is a difference in taste between the experimental group exposed to the magnetic field and the control group not exposed to the magnetic field.

CONCLUSION

Based on the results of the research and discussion above, it can be concluded that exposure to ELF (Extremely Low Frequency) magnetic field at an intensity of 1000 µT affects the taste of red sticky rice tape. The existence of magnetic field exposure causes an increase in the pH value of glutinous tape so that it affects the taste created by glutinous tape. ELF magnetic field exposure can inhibit the growth of bacteria on red sticky rice tape, so that the decay process is also inhibited.

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