THE RADIO FREQUENCY HEATING TO ELIMINATE MICROORGANISMS IN WINE PACKAGED IN GLASS JARS SEALED

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ABSTRACT

In this paper, the microorganisms eliminated for wine packaging in a sealed glass bottle by using the principle of radio frequency heating (RFH) are presented. To determine the relationship of the power and frequency appropriate for the killing of bacteria in wine, including the relationship between temperature variations with the distance of the electrode plates. It is a technique to find that involves heating directly to dielectric, because of this method involves heating efficiency is very high. In addition, the heating is also used time periods less than conventional methods. In the experimental, the electrode plates were be designed by using an aluminum material and excited by 51 MHz signal. The results found that the temperature of the wine would increase from 25℃ to 29-63℃, it will be take approximately 30-120 seconds. The temperature range of 50-60℃, it will be killed bacteria to effectively. The advantage of the principle of radio frequency heating is that it can be applied to eliminate the microorganisms for wine packaging in a sealed glass bottle.

1. INTRODUCTION

At present, the wine processes after fermentation successfully, have pasteurization wine for eliminating microorganisms in wine and clean bottle for eliminating microbial residue in the bottle, before bottling, and then sealed, were taken off distribute, but find problem microorganisms residues inside a sealed bottle. The microorganisms residues reactive fermentation inside the bottle, the results of the reaction, that is carbon dioxide bubbles so making bottle bombs fracture and bad taste wine. However, the solution by In-container pasteurization, packaged food to be pasteurized in hermetically sealed packaging and use principles heat transfer to the food, (P.P.Lewicki, 2003). But present has principles of radio frequency heating, this heating the material directly, the interest and study in this solution.

Studied, technology RF and microwave heating are technology temperature increases of dielectric material. The increase in temperature of material as a result of the absorbed electromagnetic energy (Nelson, 1996).The RF heating is direct materials, therefore, all pieces of the same materials temperature. This technology has been applied in various applications. The Agriculture applied to the dielectric heating for killing moth in rice by electric field plate, rice and moth in between plate. The rice and moth is dielectrics materials as a result of the absorbed electromagnetic energy the temperature increase, this the temperature increase killing moth in rice (Santalunai, 2015), etc. The food applied to the dielectric heating pasteurization, sterilization and post-harvest. Radio frequency heating as a postharvest treatment against codling moth in cherries (J.N Ikediala, 2001). Radio frequency heating at 27.12 MHz for the pasteurization of ham samples repacked in plastic films, the samples were brought to internal temperatures of 75 ℃ and 58 ℃ in 5 min (V.Orsat, 2004).Radio frequency electric fields treatment on Escherichia coli bacteria in apple juice at 25 kV/cm and operated at 25℃, 55℃ and 75℃ for 3.4 milliseconds at a flow rate of 540 ml/min. (Dike O. Ukuku, 2012), etc.

In this paper, the microorganisms eliminated for wine packaging in a sealed glass bottle by using the principle of radio frequency heating are presented. It is a technique to find that involves heating directly to dielectric, because of this method involves heating efficiency is very high. In addition, the heating is also used time periods less than conventional methods. To determine the relationship of the power and frequency appropriate for the killing of bacteria in wine, including the relationship between temperature variations with the distance of the electrode plates. The electrode plates was be designed by using an aluminum plate size of 31×36 cm and excited by 51 MHz signal, output voltage is

7,000 V. The temperature of the wine would be increased from 25℃ to 29-63℃, it will be take approximately 30-120 seconds. The temperature range of 50-60℃, it will be killed bacteria to effectively. The advantage of the principle of radio frequency heating is that it can be applied to eliminate the microorganisms for wine packaging in a sealed glass bottle.

2. EXPERIMENT

2.1 Experimental Apparatus

Principles of radio frequency and microwave heating. Dielectric materials, such as most agricultural products, can store part of the electric energy and convert the other part into heat in an electromagnetic field created by a RF or microwave system. The increase in temperature of a material as a result of the absorbed electromagnetic energy can be expressed by (Nelson, 1996)

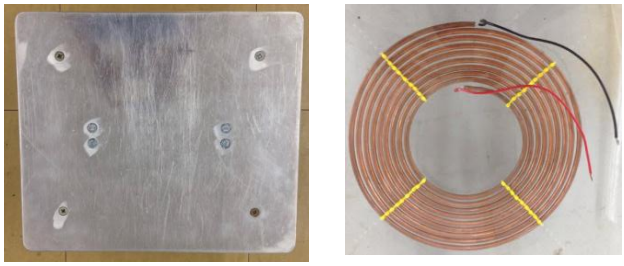
$$\rho C_p \frac{\Delta T}{\Delta t} = 5.563 \times 10^{-11} f E^2 \varepsilon'' \qquad (1)$$

where C_p is the specific heat of the material (J.kg^{-1}.℃$^{-1}$), ρ is the density of the material (kg.m^{-3}), E is the electric field intensity (V.m^{-1}), f is the frequency (Hz),ε'' is the dielectric loss factor of the material, Δt is the time duration (s) and ΔT is the temperature rise in the material (℃).

From equation (1), design source electric field and frequency which a variable we can design and build. By we build radio frequency heating system comprised a transformer source voltage output 7,000 volts and design electronic oscillator at frequency 50 MHz and use aluminum is plate size 32×36 cm in Fig. 1a).

The signal output we using tools Agilent Technology digital storage oscilloscope (Model DSO-X-2002A 70 MHz) by using inductor isolate (Fig. 1(b)) measurement signal output, sample temperatures were measured using the thermal camera (FLIR TG165 Imaging IR Thermometer).

Increase energy field by adjusting the distance between the plates, for test the difference of the electric field, the temperature increase of wine by used same time while the operation. The wine bottles are sealed and placed between the plates and the experiment was only one bottle (Fig. 2).



(a) (b)

Fig. 1 (a) aluminums is plate size 32×36 cm (b) inductor isolate

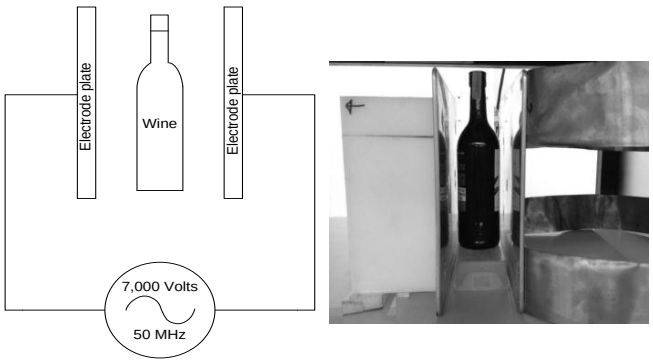


Fig. 2 The wine bottles are sealed and placed between the plates.

3. RESULT AND ANALYSIS

Fig. 3 show the comparison of temperature with the distance between the plates. When the electrode plates close at 9 cm, the temperature of wine increase 66.2℃ at 120 seconds, and when the electrode plates close at 15 cm, temperature of wine increase 35.4℃ at 120 seconds. The electrode plates even closer together, energy electric fields, even more, allows the plates closer together and make more energy than radio frequency heating the temperatures rising well over and the temperature that occurs depending on the dielectric constants of wine.

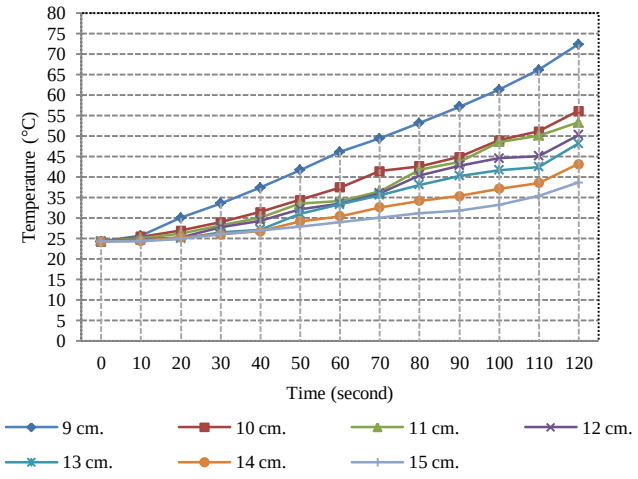


Fig. 3 The graph shows the relationship between the distances of the plates with the temperature,

Fig. 4 show that the signal output from electronics circuit, we have designed for using radio frequency heating wine by using inductor isolate. Because signal cannot be measured directly, measurement cannot withstand voltage 7000 Volts, so that the inductor isolate. Signal frequency 50MHz by there is a load of wine.

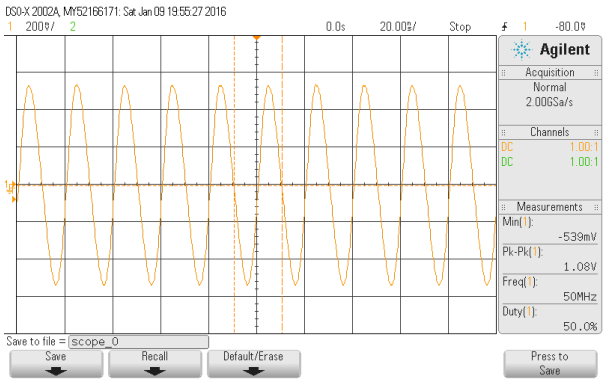


Fig. 4 Signal from the coil isolate by connected to measurement oscilloscope (have a load).

Fig. 5 show frequency 53.8MHz by no load. Because the circuit will be designed according to the load dielectrics, which dielectrics are different, the signal has a different frequency and based on the matching circuit.

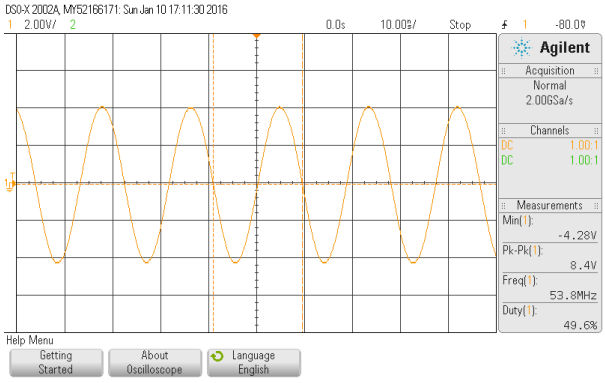


Fig. 5 Signal from the coil isolate by connected to measurement oscilloscope (no a load).

The temperature, we measured the temperature measured by the external bottle of wine. The temperature outside is greater than, approximately 4-5℃, which sufficient eliminate microorganisms in wine.

CONCLUSION

In this paper, we study the relationship of the power and frequency appropriate for the killing of bacteria in wine, including the relationship between temperature variations with the distance of the electrode plates. In the experimental, the electrode plates was be designed by using an aluminum material and excited by 51 MHz signal. The results found that the temperature of the wine would increase from 25℃ to 29-63℃, it will be take approximately 30-120 seconds. The temperature range of 50-57.2℃, it will be killed bacteria to effectively. Nevertheless, the electric field is much more energy on temperature, linear graph, heat in a sealed container it was found that when the wine is heated until the temperature reached 57.2℃ bottles to leak so dangerous. The advantage of the principle of radio frequency heating is that it can be applied to eliminate the microorganisms for wine packaging in a sealed glass bottle to effectively.

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