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Design and Manufacture of Cold Plasma Generator to Preserve Milk and Beef Samples from Components Simple and Low-Cost College

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Abstract

The cold plasma device was manufactured locally in the city of Hit, and laboratory tests were conducted on this device in the laboratories of Hit General Hospital as well as in the laboratories of the Department of Environment and Water Resources / Ministry of Science and Technology / Baghdad This device was made locally from available raw materials and cheap price, in addition to its consumption of electrical energy by a small percentage that may not exceed (1 amper), and is characterized by ease of use and transportation, and it does not need a long time when completing its work, and according to the nature of the foodstuffs used For examination, the temperature of the plasma generated by the device does not exceed (25) degrees Celsius. Cold plasma testing was performed on milk and meat samples, microbiological experiment was conducted and chemical composition analysis was performed. The microbiological experiment showed a reduction in the microbial load in the milk and meat sample, and the results of the chemical composition analysis showed minor changes in it.

Keywords: *Cold Plasma, Argon Gaz, Process, Plasma generation.*

Introduction

With increasing consumer demand for high-quality products, the food industry is looking for new technologies that can improve product safety, extend shelf life and increase food quality. Heat treatment is a commonly used and relatively economical technique in the food industry, which may destroy the flavor, color, texture and nutrients of heat-sensitive foods (Soares et al., 2017). In recent years, non-thermal technology as a new technology has been widely applied in the food industry because of its low processing temperature and because it can avoid the damage caused by heat treatment technology (Perez-Anres et al., 2019).

Plasma is the fourth phase of matter, where increases in the energy levels of matter lead to the transformation of the phase of matter from a solid to a liquid to a gas, and finally to an ionized state of the gas, the "plasma" that has its own characteristics (Bourke et al., 2017).

Due to the growing trend of processed foods, the use of cold plasma processing, a new non-thermal processing technology, is being extensively reviewed and researched. This technology uses locally generated non-thermal plasma, an ionized gas containing free molecules, atoms, ions, and electrons, in the Earth or excited state, to process foods. Cold

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plasma can be generated using different types of devices with energy inputs from different sources such as electricity, heat and electromagnetic waves (Coutinho et al., 2018).

Cold plasma is a fast, non-thermal technology that can pasteurize milk to ensure food safety while maintaining milk quality. Recent research papers have highlighted the advantages of cold plasma processing in reducing bacteria and their enzymes in raw milk and dairy products (Nooshin Nikmaram and Kevin Keener, 2022).

The quality of meat is damaged by traditional techniques, and researchers have invented a revolutionary technology called plasma technology, and it came to meet the requirements of an effective cold processing method, and cold plasma used in meat and its products in removing contamination and extending storage capacity has proven to be a great success, and the impact of cold plasma technology on the quality of meat is important for its acceptance as an alternative technology for meat processing. Having effects on color, pH, fat oxidation and microbial quality of different meat products, cold plasma technology treatment offers important benefits over conventional processing methods due to its adaptability to non-thermal and relatively inexpensive design and behavior and environmental friendliness. (Akhtar et al., 2022).

Materials and methods of work:

Manufacture of cold plasma device :

The first step to manufacture the cold plasma device was to obtain an electric potential difference that is shed on one of the inert gases (argon gas) because these gases are the most gases whose ions can be easily released, and the initial planning was to choose the components of this device from what is available in the local market and at the lowest manufacturing cost, and the method that was implemented is:

Using the Flyback transformer

The high-pressure transformer or the so-called (LINE) works to provide high voltage (acceleration voltage) with its response to high frequencies due to the property of the core carrier of the magnetic field because it is made of (ferrite), a mixture of iron oxide and some metals, and it has been used in this device to obtain a wider range of ionizing voltage frequencies of the intermediate gas and this method is currently used to generate plasma as a main circuit, and Figure (2) shows the electrical diagram of the circuit.

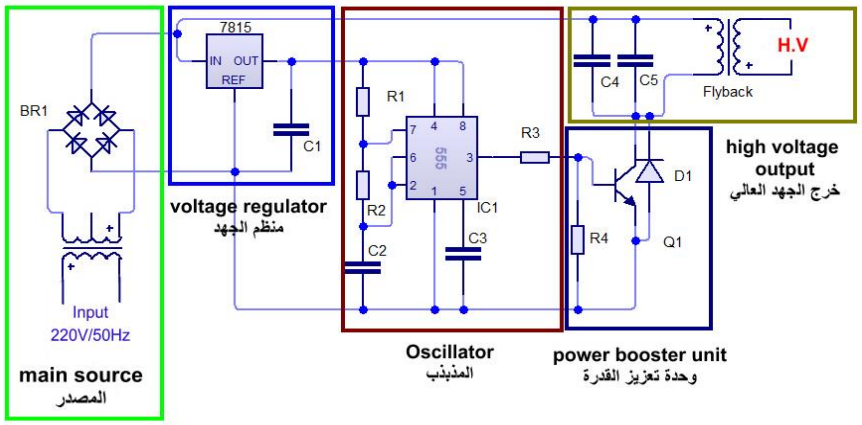

Figure 2 High voltage circuit diagram by line transformer

Microbiological experiment

Estimating the total number of bacteria

Transfer 1 ml of suitable frightening to Petri dishes (plastic or glass, depending on availability) with a sterile pipette, the culture media was poured into the sterile dishes, the samples were mixed with the agricultural medium inside the dishes by quietly stirring them on all four sides, then left to harden the medium, then placed inside anaerobic containers (Anaerobic Jar) upside down and incubated in 37 m for 48 hours after that, according to the number of anaerobic bacteria developing in the dishes (ISO, 2012).

Chemical composition

1- Protein:

Estimate the protein in the samples of milk, meat and chicken meat using the Kjeldahl device by placing 0.3 g of samples for each treatment in the digestion tube of the device and add to each tube 10 ml of concentrated sulfuric acid (95%) with two drops of perchloric acid HCLO4 and digestion continued until the solution became clear, then the digested samples were distilled after adding 10 ml of sodium hydroxide (0.1 standard), The liberated ammonia was collected in a 50 ml flusk containing 25 ml of puric acid (2%) with two drops of Bromocresol Green index and Methyl red methyl red reagent guide, then powdered with HCL at a concentration of 0.05 standard, and the amount of acid sufficient to change the color of the index from green to red was calculated and the percentage of crude protein was calculated according to (A.O.A.C, 2008) according to the following equation:

$$\text{Crude protein \%} = \frac{Quantity\ of\ HCl\ consumed\ (ml) \times standard\ (0.05) \times 0.014 \times 6.25}{Original\ sample\ weight\ (g)} \times 100$$

2- Fat :

The percentage of fat in the samples of milk, meat and chicken meat was estimated by the Soxhlet device, weighing 0.5 g of ground dried samples and placed in a special eyelid of the device known in advance, then 200 ml of solvent (petroleum ether) was added to it and the extraction process lasted about 4 hours, then the solvent was collected from the device and the drunk was taken out and placed in an electric oven for half an hour at 80 ° C to get rid of the solvent residue from the flask according to the method (A.O.A.C, 2008). Then the dried thumbal was weighed after cooling and the percentage of fat was calculated according to the following equation:

$$\text{Fat percentage \%} = \frac{Weight\ of\ Thumbel\ with\ Sample\ before\ Extraction - Weight\ of\ Thumbel\ after\ Extraction}{sample\ weight\ (g)} \times 100$$

Results and discussion:

Microbiological experiment:

The effect of cold plasma on the total number of bacterial colonies in milk and meat samples that were exposed to cold plasma for (15 minutes) and gas flow (arcon) (3 liters / min) It was noted that the total number of bacterial colonies in samples not exposed to cold plasma (190, 3) CFU decreased significantly to become (28, 0) CFU respectively after exposure to cold plasma.

Figure 3: Image of the sample exposed to cold and unexposed plasma

Chemical composition

Cold plasma affected the chemical composition of milk, where we note that the exposure of cold plasma led to a significant increase in the level of protein while there are no significant differences in fat.

Cold plasma also affected the chemical composition of meat, where we note that exposing cold plasma led to raising the level of protein and fat significantly.

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