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FOOD AND ENVIRONMENT SECURITY BY USING NON THERMAL PLASMA NEEDLE

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Abstract

The aim of this study is to use a non-thermal plasma system to eliminate bacteria that affect the quality of fresh products, food and environment security. These bacteria are transmitted by contaminated foods, especially fresh vegetables, such as cucumbers, or by plant products, using wastewater as fertilizer for agricultural products, or importing fruits and vegetables from the incubator areas for disease.

It was observed that cold plasma is useful for microbial obstruction with low growth of microorganisms and disruption of cell and altering its physical and chemical properties. Also any process of disinfecting foodstuffs is subject to operational constraints; the nutritional value of the food must be maintained and its sensory properties must not be altered to make it unpalatable or unattractive to the consumer.

Key words: Food and Environment security, thermal plasma needle

Introduction

Plasma is an ionized gas and is considered the fourth state of the universe. It consists of mobile charge conductors such as ions, electrons (Li and Jia, 2010). Cold plasma with atmospheric pressure is active in killing bacteria. For this it is useful and important in various medical applications and biological, such as: sterilization of medicinal substances and biological decontamination (Bogaests, Neyts, Gijbels and Mullen, 2002)

One type of this non-thermal plasma is the plasma torch, which is a single electrode that works on noble gas (Ar- He), which operates at a temperature close to the room and does not cause any thermal damage to the materials in contact with it.

Cold plasma has been used in sensitive disinfection of materials, now being prolonged to the food industry as a new technology. It has been considered that the cold plasma application of microbial destruction is widely discussed on various food substrates like dairy, meat, fruit, etc., it also works to change the seed germination rate. It is an environmentally A friendly process that preserves food and other technology applications as an alternative. **(**Mohammed Ubaid. Husain, 2017).

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Vegetables, fruit are contaminated with bacteria due to the use of heavy water to irrigate paper crops, use surface water contaminated with animal waste or use animal waste as fertilizer for agricultural land, especially fruit orchards. Fruits and vegetables are one of the most important and important sources in the expansion and spread of infections of these bacteria, especially since most types of fruits and vegetables are eaten fresh and not subjected to heat treatment (Ragni *et al*., 2010)

Although recent years have seen tremendous growth in basic knowledge about the factors causing food poisoning, the incidence of this disease continues to grow in Western industrialized countries. In an attempt to meet the changing demands of the community for convenient food and low-cost, it has become clear that technology to ensure their safe production. (Ragni *et al*., 2010; Mohammed Ubaid. Husain, 2015).

The decontamination efficacy and mechanism of the gas plasma towards different type of microorganisms together with the techniques able to generate the ionized gas at atmospheric conditions were widely investigated (Mohammed Ubaid. Husain, 2015). The possibility of achieving the decontamination at low levels of temperature and pressure makes the technique promising for the superficial treatment of food products.

The gas plasma potentiality was confirmed by the results of some recent researches conducted on the main microorganisms infecting fruits, vegetables. In order to study the optimal treatment conditions, the present work intends to analyse the gas plasma produced by an needle device and decontamination efficacy (Mohammed Ubaid. Husain, 2017; Ragni *et al*., 2010).

Escherichia coli is a large intestinal bacterium, the "intestinal". There is an intestinal tract for humans and other animals. Each type of host animal harbors a different breed of organism.

The most important strains of humans are those that live in us and those that live in the gut of livestock.

Colon people are an opportunistic nurse and may cause in the right place at the right time anything from a mild stomach upset like diarrhea, urinary tract infections, septicemia and meningitis. Portable *E. coli* strains are distinguished in cows and contaminated beef and named according to the virulence characteristics. The disease often occurs due to eating contaminated meat; however, the transfer of one person to another was reported. (Michael, Leboffe, Burton and Pierce, 2011)

E. coli is a classic opportunistic nurse found in fruits, vegetables as well as hospitals and elsewhere. This bacteria is one of the main pathogens that are transmitted to hospitals and other places. It contributes to a large percentage of hospital infections and the rate of infection with various Gram-negative pathogens. Nowadays, due to the multi-drug resistance mechanism of America, accidents have occurred frequently and drug resistance has increased gradually (Philippon, Arlet and Jacoby, 2002; Turk and Porter, 1975). On blood agar, colonies appeared 3-4 mm in diameter, on Makoniki agar. The colonies were red, because this organism is fermenting lactose ((Philippon, Arlet and Jacoby, 2002; Turk and Porter, 1975; Jawetz, Melnick and Adelberg, 2007)

Listeria monocytogenes (Phylum Firmicutes) are decomposing soil separators and very popular plant materials and are a common polluter of raw milk and cheese. It is found in red meat, poultry, fish and the intestinal tract of many animals, including humans. The object enters the body as a contaminant transported by food or through holes in the skin. After attachment to the host epithelial cells, it stimulates phagocytosis. Once in the phagolyso some, it produces an enzyme that breaks down the phagolysosome and releases cells into the cytoplasm. The Act 'A' protein on the surface of the cells induces the actin host to push it to the surface, through protrusions called phyllopods (Michael, Leboffe, Burton and Pierce, 2011)

From macrophages, phagocytosis is done by adjacent epithelial cells and macrophages and the process is repeated in these new cells. This proliferation mechanism protects listeria from defenses such as supplements and antibodies. L. *monocytogenes* primarily affect pregnant women and their fetus, as well as those with immune deficiency, the elderly and more recently have been associated with gastroenteritis in healthy adults. (Michael, Leboffe, Burton and Pierce, 2011; Jawetz, Melnick and Adelberg, 2007).

Materials and Methods

The decontamination efficacy was evaluated on fresh pears and containing deliberately contaminated with pathogens (*Escherichia coli* and *Listeria monocytogenes*). Food products were exposed to gas plasma for 0, 10, 20 and 30 sec. and the surviving cells of the target microorganisms were enumerated by plate countings onto unselective and selective media.

Samples were collected from water, fruits and vegetables, through a drop of the water sample sterilization was tested, switching from fruits and vegetables and bacteria culture before and after the treatment of the plasma needle, found normal bacterial growth (such as *E. coli*) cultures cultured from taking a sample controlling the amount. A large number of bacteria obtained from synthetic media (MacConkey agar, blood agar) and obtaining bacterial colonies, carried out a study of the effect of cold plasma on bacterial cultures to demonstrate the extent of sterilization and to identify potential responsible influences **(**Kennedy and Fridman, 2004) Prepared culture plates were treated with a plasma needle and (24 hours) incubated.

Experimental Procedure

At a frequency of 15 kHz and a high-voltage power source used to generate discharge in the air gap of two poles covered with insulator. With a high frequency digital

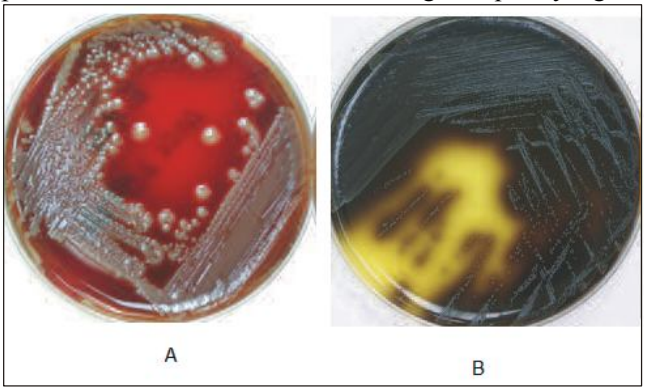

Fig. 1: (a) E. Coli in sheep blood agar; (b) Listeria Moncytogenes iin oxford medium. (Michael, Leboffe, Burton and Pierce, 2011).

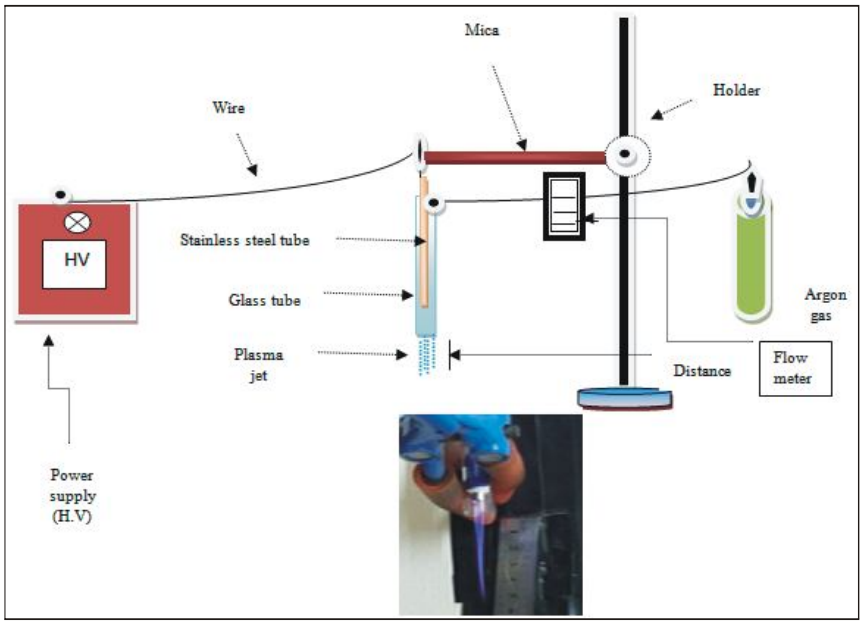

Fig. 2: Typical form of the installation of the system (Plasma Needle).

oscilloscope, current and voltage were measured. The applied voltage, discharge current measured and analyzed.

A conventional plasma discharge was adopted in this jet plasma system, which is an AC driven system. The high voltage was applied between two types of conductors, one or both of which were covered with electrical insulators in order to determine from the current and block the transition to the arc discharge.

By applying alternating voltage, cold, non-thermal plasma is generated for values from 0 to 3 kV between a high-voltage dielectric electrode and a grounded base that carries the material to be diagnosed or treated.

For sample processing and diagnosis, use a variable voltage and power supply. The electrical current is connected to the stainless steel tube.

The dielectric prevents the current from flowing between the electrodes and thus the plasma is generated with concentrations of reactive varieties and little gas heating. The distance to discharge between the used model and the dielectric is variable from 1 cm to 3 cm.

The current is determined at a frequency of 15 kHz and prevents the transition to arc discharge. The experimental form of the working scheme is shown in fig. 2 during our work. The power supply is equipped with a variable voltage from 0 to 10 kV connected with a wire of steel before the rust, the other part of the system is connected gradually with a piece of mica to prevent discharge to the mask.

Between the upper surface of the model and the bottom of the tube the discharge is generated, the diameter of the glass tube is about 2.5 cm, the atmospheric pressure and temperature of the room are the basic conditions for work.

Results and Discussion

(a) Studying the effect of argon gas flow rate on bacterial disruption:

(Fig. 3 and 4) The relationship between survival rate appears for *Escherichia coli,Listeria monocytogenes* bacteria with gas flow rate respectively.

At applied voltage 1 kV, the high rate of gas flow and the discharge of high-speed particles penetrate the outer covering of bacteria and this disrupts the bacteria caused by the plasma needle. This is why treating bacteria while increasing the gas flow rate; this contributes to destroying the cell membrane structure and distributing electrical charges on the cell membrane. The penetrating

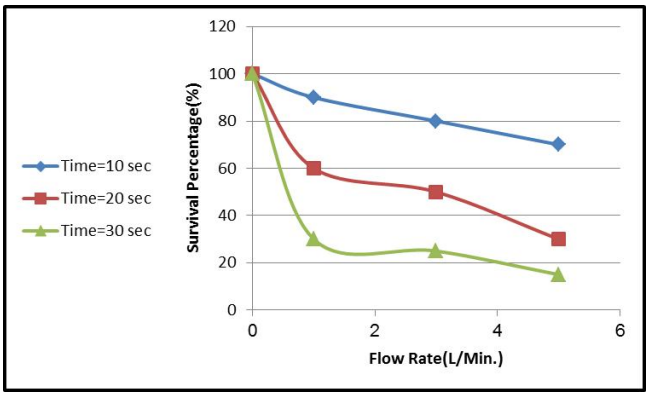

Fig. 3: Relationship between survival percentages for *Escherichia coli* bacteria with flow rate at applied voltage 1kV.

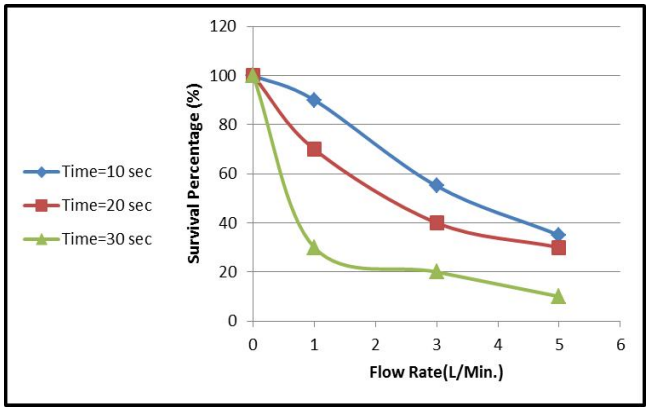

Fig. 4: Relationship between survival percentages for *Listeria monocytogenes* bacteria with flow rate at applied voltage 1kV.

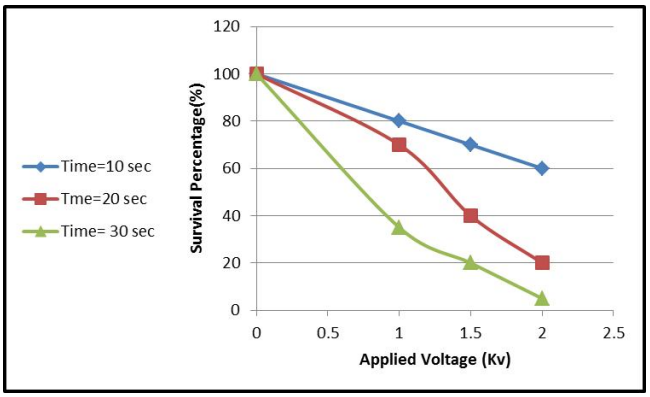

Fig. 5: At a flow rate of 1 L/ min, the survival rate for Escherichia coli bacteria is a function of the applied voltage.

effect of emptying high-speed particles, as well as from the cell wall and cell membrane, penetrates into the cytoplasm that disappears, leading to the death of bacteria.

(b) Studying the effect of applied voltage on bacterial disruption:

At flow rate 1 L/Min. Non-thermal plasma was generated at different voltages and times. Where bacteria decreased by variable proportions depending on the conditions and results of the experiments. This percentage of reduction is also dependent on the applied voltages and plasma generation for different conditions as shown in fig. 5 and 6. Results it was observed that the rate of reduction increased with increasing processing time and for several different voltages.

Through the above, the results show that the Gram-negative bacteria (*E. coli*) are more resistant to non-thermoplastic plasma than Listeria monocytogenes and this depends on the cell wall and their composition for each of these bacteria and it is known that the cell wall of each of the Gram negative cells Gram-positive cells contain peptidoglycan, which is important to protect and account for the cell. Gram's positive cell wall contains a

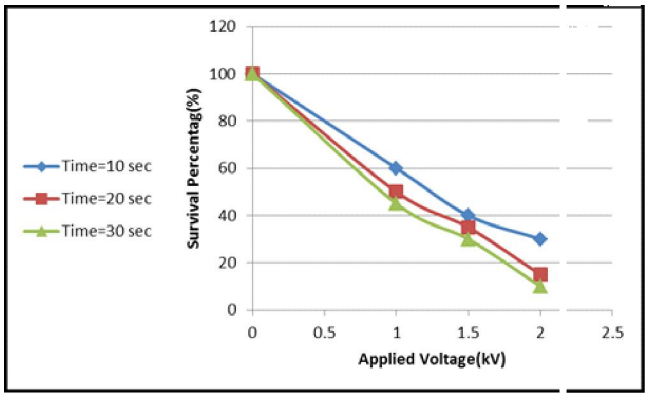

Fig. 6: At a flow rate of 1 L / min, the survival rate for Listeria monocytogenes bacteria is a function of the applied voltage.

layer of peptidoglycan, approximately 90% of the cell wall, while in the gram-negative cell wall is very thin and often contains only 10% or less of a wall Cell and hence provide bacteria higher strength and rigidity, making it difficult to sterilize and dispose of easily. (Mohammed Ubaid. Husain, 2017). Increased in applied voltage and flow rate by increasing the treatment time of exposure, this led to deactivation for two bacteria.

However, Results of the microbiological analysis showed that gas plasma was effective against both bacteria. In general the decontaminating efficacy was enhanced by increasing the treatment time and in the presence of applied voltage and flow rate

Conclusions

A non-thermal plasma system to eliminate bacteria that affect the quality of fresh products, food and environment security. These bacteria are transmitted by contaminated foods, especially fresh vegetables, increased in applied voltage and flow rate by increasing the treatment time of exposure, this led to deactivation for *Escherichia coli* and *Listeria monocytogenes* bacteria.

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