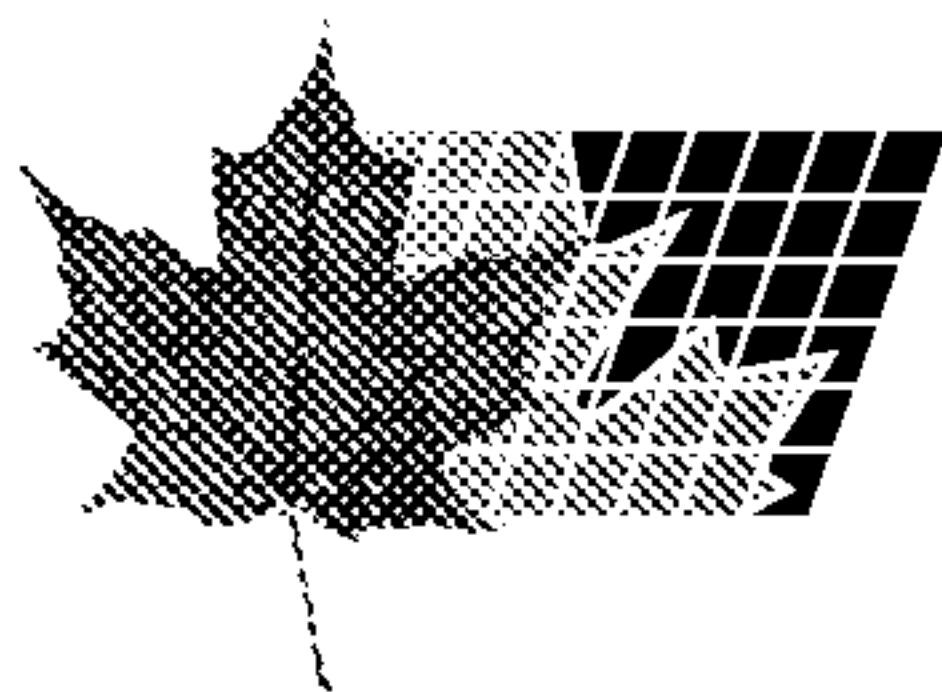




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(54) **ATTENDRISSEMENT DE LA VIANDE AU MOYEN D'UNE  
TORCHE A PLASMA**

(54) **MEAT TENDERIZATION BY MEANS OF PLASMA SPARKING  
DEVICE**

(57) A plasma sparking device is the source of controllable high-pressure acoustic pulses in a liquid medium which serve to tenderize meat suspended in said medium by inflicting impact damage on its cellular structure.

MEAT TENDERIZATION BY MEANS OF PLASMA SPARKING DEVICE

ABSTRACT

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MEAT TENDERIZATION BY MEANS OF PLASMA SPARKING DEVICEABSTRACT

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SPECIFICATION

The problem of how to resolve the conflicting aims of eating meat that is fresh and therefore relatively low in the presence of unwanted or harmful micro-organisms, and eating meat that has been tenderized by aging and is therefore high in the presence of micro-organisms, has been a dilemma of the kitchen since the discovery of bacteria.

Previously, and still in some parts of the world today, meat was improved for tenderness and taste simply by hanging it

in a cool place for a time to allow natural processes to partially break down cellular structure. The realization, particularly in the 20th century, that this so-called "aging" period also permitted the proliferation of opportunistic micro-organisms has led to much thought and research on how to economically produce meat products that have the low micro-organism count of fresh meat and the superior texture, tenderness and flavour of meat that has been hung.

A review of the literature finds that most of the effort has been directed toward finding efficacious methods of disinfecting meat after it has aged in ways that do not involve heating and consequently cooking it. This has led to experimentation involving high intensity white light, ultraviolet light, pulsed electrical fields and magnetic resonance. The utility and economic viability of any of these methods in high-volume meat production is still the subject of experiment and debate.

Less attention has been given to the possibility of tenderizing meat without aging it. Cooks have long recognized that fresh meat can be tenderized by pounding it with a mallet or the edge of a plate which breaks down the cellular structure and releases internal juices, thereby rendering the meat more palatable and tastier. However, while this will work with the individual steak or chop, it is not a practical method for larger cuts or for entire carcasses or sides. Tenderizing meat by applied physical impact has remained more a technique of the kitchen than a method of the commercial meat processor.

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In recent years, I have been engaged in technical study in an apparently unrelated field which I have discovered to have both relevance and application to the meat tenderization problem. 1008786 Ontario Ltd. through subsidiary Sparktec Environmental Inc. has been undertaking extensive research and development on the use of plasma sparker technology in an underwater environment such that the high energy acoustic pressure pulses generated by a sparker are used for aquatic anti-fouling of surfaces and, more specifically, to inhibit the settlement and colonization of underwater surfaces by aquatic animals such as the zebra mussel.

A plasma sparker comprises a pair of electrodes connected to one or more high-voltage, high-storage capacitors which are discharged by means of a controllable high-current, high-voltage switch. When discharged at high voltages (1,000-plus volts) multiple capacitors of a collective storage capacity of 50-plus microfarads can generate powerful pressure pulses emanating from the submerged electrodes. The effect is equivalent to the controlled detonation of a tiny amount of TNT and, depending on the distance from the submerged electrodes, and on the current and voltage of the capacitor discharge, very high pressure pulses in water or other liquid medium can be obtained, ranging anywhere from 100 pounds per square inch to 10,000-plus psi.

Moreover, with the installation of suitable flat, curved or dish-shaped reflectors near the tips of the submerged electrodes, the pressure pulses from the spark discharges can be directed and focused. Also, the size and configuration of the container holding the fluid can be such that the pressure pulses reflected from the sides can be focused or made to form nodes of constructive and destructive interference which can be moved about in the fluid by changes in position of the electrodes. While plain water is the preferred fluid in most applications, spark discharges can safely be obtained in water-based solutions and in some non-aqueous fluids.

Experiments by myself and others have demonstrated that the underwater pressure pulses generated by plasma sparking devices can do massive damage to the cellular structure of underwater plants and animals, particularly in the controlled circumstances described above. While free-swimming micro-organisms and very small aquatic animals can sometimes ride out several pressure pulses before being damaged, the organized cellular structures of sedentary or fixed plants and animals have been found to be comparatively vulnerable. Moreover, the cells of living creatures are relatively elastic compared to creatures which are dead. It was the realization of that simple fact that led me to experiment with a plasma sparking device as a means of breaking down the cellular structure of meat in order to tenderize it.

Embodiments of the Invention

The electrodes of one or more plasma sparking devices are immersed or permanently mounted in a water- or other fluid-filled container that internally may be mainly cylindrically shaped with parabolic surfaces at either end and which may be made or coated with a physically tough but non-reactive material such as stainless steel. Meat of any type, size or configuration is put into a tightly fitting wrapping or plastic bag, with water or other fluid added if it is necessary to ensure that all surfaces of the meat are in contact with a fluid which in turn is in contact with the inner surface of the bag. The wrapped or bagged meat is then immersed in the container and the sparker detonated the requisite number of times to tenderize the meat. Depending on the mass of the meat in the bag, and the energy output at which the sparker is set, and the configuration of the container relative to the positions of the submerged electrodes and the target meat, one or a few pulses suffice.

It follows that when the container comprises a cylinder with parabolic caps at one or both ends, positioning the submerged electrodes at the parabolic focus results in the production of parallel pressure pulses moving at right angles to the centre axis of the container. Two sets of electrodes at parabolic foci at each end of a container enable meat suspended at the centre promptly to be treated on each side. Alternatively, the electrodes of a single sparker can be at one focus and the target meat at the other such that the meat will be subjected to direct

pressure pulses on one side and reflected pulses on the opposite side. Other types of reflectors or container configurations can also be utilized.

The foregoing description should not be regarded as precluding use of the invention on foodstuffs other than fresh meat, or that the foodstuffs must of necessity be covered by plastic or other material before being immersed, or that the fluid must be water only. A brine solution, for example, results in an excellent spark at the submerged electrodes and can be used to tenderize salt-preserved meats. A sugar solution also results in an excellent spark and would be useful in the treatment of non-meat foodstuffs.

Finally, it should be noted that the spark discharge and the resulting pressure pulse do have some disinfecting effect due to ultraviolet radiation close to source, the production of free oxygen, and cavitation but these effects are incidental to the invention's purpose: to cause physical impact damage on the target foodstuff such that the foodstuff is made more palatable for human consumption

Claims

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A process for tenderizing meat whereby meat is immersed in a fluid-filled container and subjected to acoustic pressure pulses generated by spark discharges from the submerged electrodes of a plasma sparking device.
2. A process as defined in claim 1 in which the container is filled with water.
3. A process as defined in claim 1 in which the container is filled with a water-based solution.
4. A process as defined in claim 1 whereby the meat is enclosed in a plastic bag with water or other fluid added.
5. A process as defined in claim 4 whereby the plastic bag contains no water or other fluid.
6. A process as defined in claim 4 whereby the meat is enclosed in plastic or other material by a technique known as shrink-wrap.

7. A process as defined in claim 4 and claim 5 whereby the meat is enclosed by a material other than plastic.
8. A process as defined in claim 1 whereby some other food product is used instead of meat.
9. A method as described in claim 1 whereby the pressure pulses of the spark discharge are focused or made directional by means of a reflector or similar device.
10. A method as described in claim 1 whereby the container is configured such that when the container or the electrodes are moved relative to each other the locations in the fluid where nodes of constructive or destructive interference occur are made to move also.
11. A method as described in claim 9 whereby one or more of the sides of the container is parabolic or near-parabolic in shape with electrodes located in or near one or more of the foci of the parabolas.