Pulsed light decontamination meat carcasses

Identification

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How does it work?

Primary objective Non-thermal microbial decontamination of meat surface.
Working principle

Pulsed light processing involves the use of intense and short duration light pulses to inactivate microorganisms. Pulsed light spectra typically range from infrared to UV-light, but it is mainly the UV radiation that causes the microbial inactivation.

The advantages of this technology for meat applications are the high energy input and the short duration time of each pulse that lead to only a minor heating of the meat surface compared to other treatments. Compared to continuous UV irradiation, pulsed light shows better penetration potential through materials like meat and consequently reach a deeper and more thorough decontamination of the surface. Despite the increased penetration, only a thin layer of the surface is quickly heated, because of the short duration of exposure to the light pulses. The heating of the underlying material, resulting from thermal conduction, is lower for application of pulsed light compared to continuous radiation. This makes the technology very applicable for food and meat products. The extent of inactivation depends on the surface evenness and moisture content, as well as on the microbial load and resistance of different strains. Pulsed light affects pathogenic and spoilage microorganisms, moulds, parasites and insects such as Salmonella, Listeria or Lactobacillus. More details regarding the pulsed light treatment for decontamination of meat can be found here: [2, 3, 4, 7, 9, 10, 13].

Images

Additional effects A possible colour change, lipid oxidation and odour generation induced by pulsed light processing can affect the meat and meat products quality.

Important process parameters • pulse width and number
• input voltage
• UV radiation power
• absorbed dose
• distance between radiation source and food and packaging use
• direction of the incident pulses

Important product parameters • water activity
• fat and protein content
• surface roughness
• product shape
What can it be used for?

### Products
In addition to meat carcasses, pulsed light can be used for microbial decontamination of other meat products, in a final or processing stage. The requirement of an effective decontamination is an as plain as possible surface of product. The technology is also suitable for decontamination of packaging materials immediately before the packaging process. The effectiveness of meat treatment through packaging material is under evaluation. More details about the general suitability of other products can be read in Pulsed light for microbial inactivation.

### Operations
The technology can be used for surface decontamination of raw or processed meat. Examples are: Inactivation of *Listeria monocytogenes* on ready-to-eat cooked meat products, decontamination of unpackaged and vacuum-packaged boneless chicken breast, decontamination treatments for pig carcasses, decontamination of chicken breast surface, intervention strategy against *L. monocytogenes* and *Escherichia coli O157:H7* on the surface of a meat slicing knife, decontamination of sliced ham [5, 6, 8, 11, 12, 14].

### Solutions for shortcomings
Pulsed light can resolve the meat industry need for a physical, non-thermal and low energy surface decontamination. Alternative surface decontamination techniques such as use of bactericidal agents (chlorine, electrolysed water, organic acids) have a low consumer acceptance and are limited by food regulations in many countries. Heating by use of gas burners or condensing steam results in higher energy consumption and protein denaturation.

What can it NOT be used for?

### Products
Restrictions are related to product type, shape and roughness as well as legislative issues. The technology cannot be successfully applied for treatment of products with a rough surface or uneven shape, as shadow effects limit the efficacy. Very porous surfaces or high reflecting or absorbing properties of materials, such as proteins or fat, can restrict the efficiency of decontamination or can lead to a heat up of the product. Dry cells of microorganisms (e.g. *L. monocytogenes*) are more resistant to irradiation than moist cells [1]. This could cause on the one hand an insufficient decontamination or on the other hand an undesired change in the exterior of treated meat.

### Operations
The process can only be used for surface decontamination, not for treatment of the whole products.

### Other limitations
- Depending on the country, products treated with UV must be declared accordingly. Consumers could hesitate to buy these labelled products.
- Products with uneven colour or dark pigments result in a non-homogeneous treatment.

### Risks or hazards
Possible risks are associated with the high energy irradiation for the operators of the plant. Direct exposing of humans to UV-C is dangerous to the extent that it can mutate RNA and DNA.

Implementation

### Maturity
The technology is in industrial use for surface decontamination of packaging material such as films or cups. Applications to decontaminate food surfaces on an industrial scale are not very common so far.
Modularity /Implementation
In general, a pulsed light operation can be easily implemented into existing production lines. When designing the processing equipment, certain key prerequisites have to be taken into account. A homogeneous treatment intensity distribution is key to achieve safe products and has to be ensured by product-adapted positioning of light sources and/or product orientation. Facilities have to be designed in order to ensure the control of high energy UV radiation for the operating personal and the environment.

Consumer aspects
Hardly any consumers have already discovered the technology for the application of surface decontamination. Proper information about the safety and benefits could increase the level of acceptance of pulse light treated products.

Legal aspects
depends on wavelength of radiation, use has to be declared

Environmental aspects
The technique results in a lower energy consumption than traditional thermal decontamination processes. Compared to organic acid dipping, no chemicals or ingredients are required.

Facilities that might be interesting for you

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<tr>
<th>Title</th>
<th>Institute/company</th>
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<tbody>
<tr>
<td>Lab scale oven for infrared and impingement heating - SP</td>
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<tr>
<td>Pilot scale tunnel oven for infrared and impingement heating - SP</td>
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<td>Pulsed light labscale IRTA</td>
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<td>UV irradiation - FRIP</td>
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Further Information

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<th>Institutes</th>
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<td>DIL, Ghent University - NutriFOODchem, Institute of Meat Hygiene and Technology, Belgrade</td>
<td>Steribeam, Claranor</td>
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References


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