Industrial uses of ozone

José Garcia-Reverter

AINIA TECHNOLOGY CENTER

Ozone (O3) has a growing number of applications of interest to the agro-food industry, including water disinfection, odor treatment, prevention and control of *Legionella* in cooling towers, sanitizing equipment and facilities, and the preservation of food and raw materials, among others. It is therefore, a valuable new ally to achieve the highest levels of quality and food safety as well as improved environmental management in food industries. Therefore, the AINIA Technology Center has worked on this technology for more than 10 years, and its innovative projects have contributed to the development of some of these applications in the sector.

But how is ozone used? Ozone for agro-industrial use is easily obtained from atmospheric oxygen by means of pieces of equipment called "generators". During the process, a stream of dry air goes through concentric electrodes where an electrical discharge excites the oxygen molecules (O2) in the air. These molecules react with each other and form a transitional ozone (O3) in the form of gas. The ozone produced can be directly applied in the gas phase, for example in food storage chambers, or can be dissolved in water (ozonated water) to be used in the washing and disinfection of vegetables.

What is its main advantage? Ozone has a very high oxidizing power that is able to destroy most microorganisms in a rapid and irreversible way. We are therefore faced with a broad spectrum biocide similar in effectiveness to chlorine and its derivatives, or other chemical disinfectants. Another key advantage is its safety. Unlike products such as chemical disinfection, ozone carries out its bactericidal function and, after a short period of time, it returns to its original state in the form of oxygen. Thus, the process provides the guarantee that no undesirable chemical residue will be present on the surface of food or in the water treated by an inappropriate procedure.

The presentation aims to provide an overview of current knowledge and recent progress made in the use of ozone, their mechanisms of action, aspects of engineering, safety of use and environmental issues in the context of a Sustainable Food Industry.

Non-Invasive Technologies for on-line evaluation of meat quality for processing

Roberta Virgili, SSICA

The concept of meat quality for processing is based on a pool of markers associated with meat response to the main technological treatments like salting, drying, mincing and cooking. Meat response is meant as the complex set of sensory, physical and chemical changes occurring in meat after the application of the above mentioned treatments. The aim of non-invasive technologies for meat evaluation is to measure and analyze meat quality data prior to the processing of the meat itself. Several techniques have been developed during the last two decades to replace subjective visual evaluation of meat cuts made by skilled operators with on-line speedy devices capable of measuring meat quality parameters, in order to found the technological process on science-based data. The development of equipment capable of relating signals coming from non-invasive stimulation of meat to water distribution and status, fat amount and composition are closely related to the application of sensor technology, and statistical methods of prediction and calculation of algorithms for meat classification. Fast non-invasive technologies for on-line evaluation of meat quality are mainly based on physical methods, like Nuclear Magnetic Resonance Imaging (MRI) and Magnetic Induction Spectroscopy(MIS), X-ray Computed Tomography (CT), Visible and Near Infrared Spectroscopy (VIS-NIR), Video Image Analysis (VIA), Conductivity and Ultrasound application. In view of improving final product quality and consistency, tools for on-line meat quality evaluation are receiving increasing attention from the meat industry.

Early phases in consumer-driven food product development

Sebastiano Porretta, SSICA

Concept analysis is a market research tool used to evaluate and/or help develop product or service features: a versatile marketing research technique that can provide valuable information for new product development and forecasting, market segmentation and pricing decisions. Concept tests can answer to a wide number of questions including:

Which new products will be successful?

Which features or attributes of a product or service drive the purchase decision?

Do specific market segments exist for a product?

What advertising appeals will be most successful with these segments?

Will changes in product design increase consumer preference and sales?

What is the optimal price to charge consumers for a product or service? Can price be increased without a significant loss in sales?

A widely used tool, Conjoint Analysis is a decompositional method that seeks to identify which product or service traits are most desirable by estimating the structure of consumers' preferences given their overall evaluations of a set of alternatives that are pre-specified in terms of levels of different attributes. The advantage of conjoint analysis is that respondents are asked to evaluate products in the same manner as consumers, that is they trade off characteristics against one another during the evaluation process (the term conjoint is a contraction of consider jointly).

The result is an aggregate of individual models to group models based upon total panel or key subgroups.

Challenge tests – testing the microbiological stability of chilled food

Michael Benner, KIN

According to Regulation (EC) 2073/2005 on microbiological criteria for foodstuffs, the limiting value for *Listeria monocytogenes* of 100 cfu/g must not be exceeded in ready-to-eat food during the entire shelf life.

Ready-to-eat food with pH <= 4.4 or an aW of <= 0.92 or pH <= 5.0 and aW <= 0.94, respectively, are on the safe side as they do not promote the growth of *Listeria monocytogenes.*

For all other ready-to-eat food, scientific examinations could prove that they also fall into this category because apart from intrinsic factors such as the ones mentioned about, other product characteristics including use of inert gas, preservatives or treatment with smoke may affect the growth of *Listeria monocytogenes*. In these cases, the food safety must be verified in respective tests.

One test suitable for verifying the growth potential of *Listeria monocytogenes* in food is the so-called challenge test according to Sanco 1628/2008 (Guidance Document on *Listeria monocytogenes* shelf-life studies for ready-to-eat foods or the respective technical guidance document).

The method will be introduced.

Pulsed light for surface decontamination

Edyta Margas, Campden BRI

Pulsed light is a novel system that can be used for surface decontamination of foods and food contact surfaces, including packaging. The technique, which has been shown to be effective against bacteria, spores, yeast and moulds, involves flashing surfaces with intense, short duration pulses of broad spectrum white light. Pulsed light can inactivate microorganisms on the surfaces of objects. Although the magnitude of inactivation varies from surface to surface, Campden BRI found significant effects on both stainless steel and PET food contact surfaces. The irregular nature of food surfaces, in which shadowing is an issue, makes the use of pulsed light less straightforward. The nature of the food also has an effect. For this reason it is important that each product is properly investigated to ascertain effectiveness. Pulsed light is commercially used to decontaminate packaging material, cups and closures. It does not use water and chemicals therefore it can be used in the factories where water presence has to be minimized.

Effect of high-pressure/high temperature processing on ready meals

Elisabeth Payeux - CTCPA

The conventional thermal treatments required for low-acidity canned food products lead to an excessive impact on sensory and nutritional properties, due to high temperatures. An alternative treatment could be high hydrostatic pressure associated with high temperatures, which should have a limited impact on quality while ensuring the destruction of vegetative and spore-forming bacteria. The advantages of this process are: (i) preservation of organoleptic and nutritional qualities, (ii) innovation for products that are not acceptable with conventional heat treatments.

CTCPA is conducting a study on pressure-assisted thermal processing applied to ready meals formulated with pre-cooked pasta, pieces of zucchini, chicken cubes and a creamy curry sauce, in self-standing plastic pouches. This treatment includes preheating followed by pressurization with pre-heated water at 600 MPa for various durations according to the required F_o values. The temperature increase is fastened due to adiabatic heat generation in whole volume during pressurization. Efficiency of treatments is investigated with natural and artificial contamination using high heat resistant spores. Results indicate that duration for High Pressure/High Temperature treatments can be reduced by 50%, compared with conventional retort treatments. Sensory qualities of HP/HT food is enhanced compared with retorted control: reduction of cooking effects, firmer texture of zucchinis and pasta and less browning of the sauce.

Stabilization of low acidity canned food by High Pressure Assisted Heat Treatment is a promising method for the production of shelf stable products with improved quality. This process has great potentials in terms of texture preservation of vegetable, global sensory quality of products and inactivation of heat resistant spores. Further experimentation is needed to validate biological stability with several sporulated bacteria of reference, including strains showing specific resistance to heat under high pressure.

Spectral vision as applied in the quality control of processed food

Ricardo Diaz, AINIA

Machine vision is a technique currently used in the food industry to control quality in many production processes. However, it can be applied only when the characteristic of interest can be measured in the visible range. Industry is demanding new inspection techniques able to detect non visible properties, chemical composition or defects that cannot be seen in the visible range. Hyperspectral imaging is a powerful technique that combines information of spatial distribution and chemical composition. A hyperspectral system is formed by an extended range camera (Visible and Near Infrared), a spectrographic optic, a focusing optic and a collimating optic. Applying multivariate statistical algorithms to the hypermatrix obtained from the camera, it is possible to obtain information about the chemical composition and other properties of the inspected product. The number of applications of this fast and non-destructive technology is really huge: measurement of moisture, fat and protein of all batches (not only a small sample), measurement of sugar or acidity content, detection of foreign bodies with different compositions, etc.

Infrared and microwave processing in the food industry

Lilia Ahrné, SIK

Microwave and infrared processing has many applications within the food industry giving large advantages in terms of energy consumption, water savings and product quality. Although these technologies have been studied for quite some time, the number of openly known applications which are commercially successful in the food industry is still limited.

SIK has performed research on microwave and infrared processing for more than 20 years and several commercial lines are in use today as a result of this work. In this presentation, "Success stories" regarding application of microwave and infrared processing in the food industry will be presented and bottlenecks for implementation will be identified.

Food transparency and use of Future Internet in the agrifood chain

dr. András Sebők, Campden BRI Magyarország Nonprofit Kft.

Transparency is a hot issue in the food sector. Within the Transparent_Food FP7 project the current successful practices and gaps in the knowledge are investigated. Transparency deals with building up credibility for consumers and customers through provision of appropriate information for informed decision and by generating the perception of being informed. Transparency is built on traceability. Mostly similar practices are applied in the different domains such as food safety and quality, sustainability, social and ethical values. Successful practices are built on prioritisation, aggregation and effective communication of information. The presentation will cover the main lessons learned on transparency practices.

Successful practices include: sharing information with clients on specific lots (using identification codes) through: web-based systems and detailed documents; sharing information with consumers on specific lots through web-based systems using a lot identification code on the retail packaging; information about the chain members involved in the supply of the product, about their operations and practices, products (illustrated by descriptions, videos, photographs, virtual and actual site visits); the location of their sites and origin of their ingredients; Use codes (instead of real names) of chain members to ensure confidentiality to show the route of the products; Providing free access to consumers to requirements of standards on which transparency statements and signals are based; “Open days” of agricultural and food processing plants; Understandable explanation of the different transport documents for consumers; Provision of indicators, benchmarking and self-assessment tools showing information on advantages and disadvantages of products and systems to support informed decision making (e.g. carbon footprint calculator, toolboxes); Collective website for SMEs for sharing information to improve transparency.

Awareness is the knowledge and understanding of a subject. Transparency serves a part of the awareness needs. The use of the internet can help to meet awareness and transparency needs. The SmartAgriFood EU FP7 project is aimed at boosting the application of the Future Internet in the agrifood chain as a whole and in particular in 3 use case areas: smart farming – precision agriculture, smart agrilogistics and smart food awareness.

Expected functions of the Future Internet: the Internet parts away from the PC-s – direct communication between the machines, equipment, sensors, mobile phones, household refrigerators etc.; direct control and harmonisation; Services and access to the network do not depend on the location; Network of services; It is a prerequisite that a practically applicable standardisation will be developed and implemented; Mobile phone works as a data collector, a data viewer (display) and an information transmitter; Quick and real-time exchange of large amount of data/video/3D information; Virtual design facilities; Content based browsing - intelligent distribution and caching of content; Services of customized information following selection of filtering criteria set by the users; Positioning with higher accuracy for exact identification of objects, controlling of the (agricultural) machines; Cloud computing – ability to handle tasks requiring high data processing, computing capacity; Higher privacy - guarantee for the protection of personal data; Global data warehousing and management capability.

The presentation will explain the envisaged functions of the Future Internet and some concepts for potential applications.