Main Topic

To the Orient - Shanghai Stopover

In the frame of our partnership agreement, we are organizing the third Franco-Chinese Workshop along with Tsinghua University's Division of Supercritical Fluids which represents the Chinese working group on supercritical fluids. This workshop will bring together twenty scientists and industrials from both countries. The programme is composed of various parts. The 5th of June will be split into laboratory visits in Shanghai and followed by an opening dinner. The 6th of June will be devoted to scientific and industrial conferences at the Rhône-Alpes Pavilion - we remind you that the pavilion is a copy of 'INEED' the eco-designed building we have in Valence and in which IFS located. These conferences will address research areas such as materials, biomass valorisation and more industrialised areas such as extraction of compounds for the food and pharmaceuticals. The conclusion will be on the position of supercritical fluids applications among Green Chemistry. A third day will be devoted to more informal interactions between the two delegations.

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To the East - stop in Tokyo and Sendai

IFS is organizing a 5 days study visit from the 8th to the 12th of June 2010 in Sendai, Japan, and around Tokyo. Ten IFS members will participate to the study visit with visits of research centres such as the prestigious AIST (Advanced Industrial Science and Technology) equivalent of the French CNRS and also companies using supercritical fluid technology in their industrial processes such as cleaning air filters, the destruction of waste, extraction of natural products. The aim of the study visit is to exchange with our Japanese counterparts, throughout the visits and during the two workshops presenting activities of members from both delegations. This event is co-organized with the support of Mr. Masaru Watanabee, of Tohoku University in Sendai whom IFS meets every year since 2008.

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Supercritical Fluid Innovation

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Newsletter

Supercritical Fluid innovation

Edito

Dear readers,

For IFS the beginning of 2010 is characterized by openings, opening to complementary technologies to supercritical fluids with the BIO N'Days event and the participation to the Eco-EXTRACTION working group, opening of a window on Asia with the study visits and the workshop in China and Japan.

Thus I.F.S in partnership with Enterprise European Network, the Rhône Alpes Chamber of Commerce and Industry, the Rhône Alpes Organics Cluster and the Drôme Chamber of Commerce and Industry, propose a 3 days programme of conferences from the 21st to the 23rd of April 2010 and a brokerage event for professionals from the agro-food, cosmetics, sanitation and packaging sectors on all conservation, extraction and separation technologies.

As for Asia, I am delighted to take a delegation of ten IFS members in China and Japan. In China, IFS will hold the third Franco-Chinese workshop in the Rhône-Alpes Pavilion at the World Exposition in Shanghai: a powerful symbol of the presentation of green technologies in an eco designed building for an exhibition focused on sustainable development! In Japan, the study visit is the occasion to launch our first Franco-Japanese workshop and will be followed by visits of laboratories and industries that are well settled and developed in Japan but only about to be developed in Europe.

Last but not least, the beginning of 2010 was also characterized by the membership of three new organisations to IFS, they are representative of the diversity of stakeholders in that sector: an SME specialised in food supplements (SYNTHEVERT System Industry), an industrial group expert in Environment (SARP Industries, the group Veolia Environment) and a research laboratory working on the synthesis of materials (LICB: Interdisciplinary Laboratory Institut Carnot Bourgogne).

Enjoy reading this newsletter!

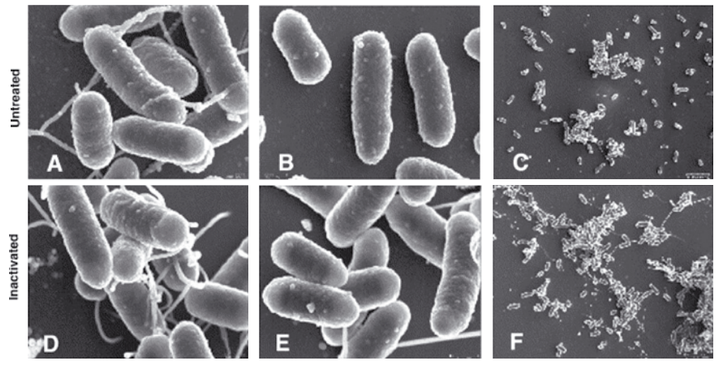
Stéphane SARRADE,
IFS President

Main Topic

Sterilization with sc CO_2

Well known for their solvent properties, supercritical fluid can also offer new opportunities for the sterilization of food.

Thermal sterilization processes using temperature as an agent to inactivate or destroy micro-organisms have appeared for several decades as reliable methods, controlled and effective for preserving food. Yet, more and more they are accused for what is characterizing them: work at high temperature and thus distort the organoleptic or nutritional properties of foods by destroying heat-sensitive molecules: vitamins or some flavours, texture agents, or natural colouring. Toxic compounds can also be produced when processing. The agrofood sector is therefore requesting processes working at low temperature while achieving the performance of thermal processes in terms of destruction of micro-organisms.



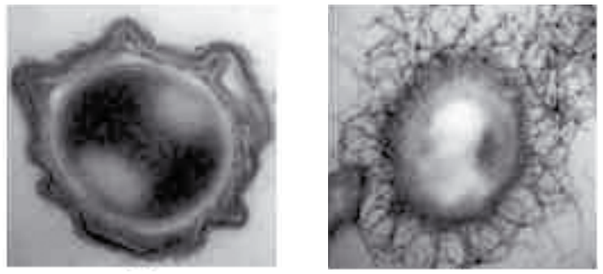
Inactivation of Salmonella by supercritical CO_2. In this case, the inactivated cell remains intact. A WHITE, and al., Effective terminal sterilization using supercritical carbon dioxide, Journal of Biotechnology, 123, p. 504, 2006.

Coming Events

- **21st - 23rd April 2010:**
  B.I.O.N'Days, Valence
- **9th - 12th May 2010:**
  12th European Symposium on SCF - Graz
- **4th - 13th June 2010:**
  Visits and workshops China, Japan

Main Topic

Sterilization with sc CO_2



(a) (b)

Inactivation of spores by supercritical $C0_2$ and additives (Zhang and al. 2005)

Parameters	reference	treated
	mean	mean
Brix (°)	11,8	11,7
Fructose (g/kg)	64,2	64,3
Glucose (g/kg)	15,0	14,6
Saccarose (g/kg)	30,7	29,1
Total acidity (meq/kg)	11,6	11,6
Malic acid (g/kg)	4,5	4,4
Citric acid (g/kg)	3,3	3,2
Ascorbic acid (g/kg)	1,8	1,9
Polyphenols (mg/kg)	580	622

Analysis of chemical composition on an apple juice before and after treatment, S. Spilimbergo and al. ISASF meeting 2008

Several technological solutions have been proposed since a few years to meet the increasingly binding specifications on the quality of the sterilized product. Among them we may name the use of conservation additives or irradiation but these techniques, although they are efficient they are welcomed cautiously by consumers who judge them to be not so «natural».

The technique of high pressure seems more appropriate. It consists in exposing without warming foods at high pressures (100-7500 MPa) with variable time periods (5-20 min). This process, also known under the name of High Hydrostatic Pressure (HHP), is now used industrially for purée or jams, but particularly in Japan and France on fruit juices. Its development is however limited due to the pressures required and costs involved. The use of CO_2 allows meeting these requirements while operating at lower pressures than with the HHP, and temperatures can not destroy the molecules of interest present in foods. Many studies have been conducted on this subject, including in Japan and in Italy, where teams of Professor Bertucco and Sara Spilimbergo (University of Padova) have done advanced work.

The killing of insects, larvae and eggs by the use of CO_2 under moderate pressure (3-30 bar) for periods ranging from 20 to 30 minutes has already proved to be worth it and is used industrially in Germany for the treatment of plants perfumes, aromatic and medicinal plants or in Asia for the destruction of weevils in the rice flour. Then, what about micro-organisms such as bacteria or spores?

We now know that most bacteria are eliminated under the action of supercritical CO_2 at pressures between 75 to 200 bar at a low temperature (35-40 ° C) that keeps the organoleptic and nutritional qualities of food. At the cellular scale, the action of supercritical CO_2 is characterized by piercing the cells and introducing into the intracellular space resulting in carbonate precipitation, extraction of cellular lipids, decreasing pH causing inactivation of key enzymes and thus breaking the metabolic chain. Depending on the treated system, the cell can be destroyed or remain intact. The key parameters in addition to pressure and temperature are the time of contact, the presence of water (which can impact on the pH) but also the introduction of pressurization / depressurization cycles that can accelerate the phenomenon.

The inactivation of spores seems to be more complex for a complete sterilization because of their resistance to these pressure and CO_2. The studies undertaken in this field by Prof. Matthews and especially Zhang (University of South Carolina) suggest that using a higher temperature (but still lower than thermal processes) or additives such as hydrogen peroxide or alcohol can effectively destroy the spores and obtain a stable product. A research effort is nevertheless still required in this area.

The fact remains that the literature provides sufficient evidence to consider an industrial of the process. Among the outstanding publications include a study by the University of Padova (Italy) on the comparison between a fresh apple juice and apple juice treated by supercritical CO_2 which has a similar chemical profile (in terms of vitamin C or polyphenol) or study conducted by the University of Aquila (Italy) for the cold sterilization of whole milk which organoleptic quality after treatment was considered by a panel of experts as better than milk pasteurized by heating processes.

Main parameters:

- P: 3-200 bar
- T: 25 à 60°C
- Duration: de 1 à 75 minutes

Advantages:

- Low temperature
- Low CO_2 consumption
- No chemical additives (except in the case of spores)
- Conservation of organoleptic and nutritional qualities of processed foods

Implementations seems to be diverse and literature mention both batch processes and semi-continuous or even continuous. The method porocrit ®, suitable for treating liquid uses a membrane contactor to reduce treatment time to one minute for values from 20 to 60 minutes in the case of batch or semi-continuous.

To sum up we can say that there are now sufficient studies and devices (patented or not) to allow rapid industrial development for the inactivation of bacteria. The implementation is more complex and requires further studies for inactivation of spores but also viruses (the use of supercritical CO_2 being considered for sterilization of medical equipment). The road is open and industrialization is ready for the implementation of tools for the destruction of microorganisms using supercritical CO_2. Moreover, equipments already exist, in France, Spain or Germany.

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IFS, Partner of “ECO-EXTRACTION” GROUP

IFS joined the “Eco-extraction “ (Green-Extraction) working group led by three French competitiveness clusters: PASS, TRIMATEC and PEIFL and, in partnership with the “Green” Laboratory of Avignon University. The group is composed of raw materials producers (fruits, vegetables and plants), ingredient manufacturers, equipment manufacturers, technical centres and research laboratories from the three competitiveness clusters.

The objectives set by the working group are to foster exchanges between stakeholders from the 3 clusters and enlarge the range of technologies and skills in order to bring companies into collaborative R & D projects or in collective activities to improve their economic and environmental performance. The group is working more specifically at the definition of green extracts with a sub-group (processes, raw materials, by-products).

The next meeting of the Working Group will be held on April 23rd at INEED, Valence just following the B.I.O.N’ Days event as it will be a great opportunity for IFS to show and present its laboratory equipment for supercritical $C0_2$ extraction.

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