Packaging Material for High Pressure Treatment (HiPP)

(CORNET)

Coordination: Forschungskreis der Ernährungsindustrie e. V. (FEI), Bonn

National Agencies:
- AiF - German Federation of Industrial Research Associations, Germany
- IWT – Institute for the promotion of Innovation by Science and Technology, Flanders/Belgium
- FFG – Austrian Research Promotion Agency
- IMPIVA – Valencian Institute of the Small and Medium-sized industry
- RPF – Research Promotion Foundation, Cyprus

Research Associations:
- TfT – TECHforTASTE, Lebring/Austria
- Itene – Instituto Technologico Logistica (Packaging, Transport and Logistics Research Center), Paterna/Spain (Valencia)
- BPI vzw – Belgian Packaging Institute vzw, Zellik/Belgium (Flanders)
- CyAQ – Cyprus Association for Quality, Nicosia/Cyprus

Research Institutes:
- DIL – German Institute of Food Technologies, Quakenbrueck
  Dr. Volker Heinz/Prof. Dr. Stefan Töpfl
- ofi – Austrian Research Institute for Chemistry and Technology, Vienna/Austria
  Dr. Johannes Bergmair
- BPI bvba – Belgian Packaging Institute bvba, Zellik/Belgium (Flanders)
  Leo Goeyens
- Itene – Instituto Technologico Logistica (Packaging, Transport and Logistics Research Center), Paterna/Spain (Valencia)
  Carmen Sanchez Reig
- FRC – Frederick Research Center, Nicosia/Cyprus
  Dr. Michalis Menicou

Industrial Branch: Meat Processing Industry

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Volume: € 1.440.000,-- (total)

Initial Situation:

Market and consumer demand has triggered the need for the development of a number of non-thermal approaches to food processing, of which high-pressure technology has proven to be very valuable. High pressure treatment is a cold pasteurization method employed for shelf life extension and pathogen reduction while retaining the foods inherent colour, flavour, nutrients and texture. The preservation of foods by high isostatic pressure belongs to the promising modern methods of food processing. This process is carried out in flexible packaging materials. So far there is not much information on the influence of high pressure on the properties of suitable polymer packaging materials. Consumer demands for high quality foods are driving the development of the high pressure

treatment. In accordance with this the EU legislation requires that compliance of food contact materials (i.e. packaging materials) with the legal requirements must be assured at each stage of the supply chain. Foods are HP-treated in a fluid that acts as a pressure transmitting medium. The food is already packaged in flexible packaging materials which serve as a barrier against the ambient environment.

Among commercial plastic materials, polyethylene and polypropylene are mostly used because of their thermo seal ability and barrier properties. It is required that the packaging material maintains the flavour, but plastic materials may interact with food components (migration and scalping) and produce undesirable effects. The mass transfer of food constituents into the (scalping), as well as the transfer of contaminants to the food (migration) often causes the loss of quality of the packed product. On the one hand, migration influences the safety of the packed food, whereas scalping affects its sensorial properties. Furthermore, fundamental information on how specific materials behave under pressure individually and which conclusions can be drawn for the design and construction of the mostly used packaging systems (i.e. homogenous material, multilayer material). The overall objective of the proposed project is to enable SMEs to implement high pressure treated food products into their product portfolio, adapted to respond to consumer demands for a high diversity of convenience food products which should be nevertheless healthy, fresh and nutritious. To meet this demand better, the influence of different aspects has to be investigated.

Research results:

20 materials were selected for detailed examination pressure induced change in properties. Relevant process parameters were defined in consultation with the project partners. The films were exposed to high pressure process with different pressures (400 MPa - 600 MPa), holding times (3 min - 5 min) and temperatures. Mechanical, permeation and migration properties were evaluated before and after the treatment. Additionally, trials were performed with the application of foods e.g. Ham, Gazpacho and Halloumi, in best suited packaging material.

In performed tests, only multilayer films with a good adhesive quality withstood unscathed the high pressure treatment. Only multilayer films developed for pasteurisation and sterilization are useful as packaging material in the application of high pressure treatment. By other qualities there is a delamination between different layers after treatment.

Coatings as an Al-metallized barrier layer are be often damaged during the high pressure treatment. The barrier properties are decreased significantly.

Several tested films with a polyamide layer out site had a decreasing of the oxygen barrier properties after treatment. This polymer PA is very water sensitive, so that the properties of this polymer can be changes by processing under water and pressure induced reactions.

In case of a high amount of (protective) gas in the packaging, gas can penetrate in the polymer during the high pressure treatment and after pressure drop then foam blisters are left behind in packaging material.

In migration tests, in general all investigated material showed suitable for high pressure treatment with the exception of one material. What was in general surprising was the high standard deviation of the treated samples compared to untreated samples.

It was shown, that the high pressure treatment under industrial process conditions have no significant changes on the packaging integrity based on bond strength and permeation. Only one composite material PETX12/PET23/PE50 showed measureable differences in bond strength, water and oxygen permeability. Small changes were detected in structure of materials oPA15/PE30 and PET12/ALU9/PE75.

The overall migration and specific migration for the therefore relevant substance CAS 2082-79-3 were below the legal limits except for the film PETX12/PET23/PE50.

It could not be observed, that higher temperature as well as longer process times are lowering the migration values based on the increased cristallinity of the polymeric material.

From tested films, a composite film PET/AL/PE was selected as best suited packaging material to perform the trials with real food (Halloumi, Gazpacho and Ham). This composite shows in general good barrier properties before as well as after high pressure treatment. No negative influence of high pressure procedure on the

packaging material or interaction between packaging and food were detected.

Furthermore, the use of the film PET/PE/PA/EVOH/PA/PE is eminently suitable in terms of its barrier properties for packaging food that has to be high pressure treated. Depending on the requirements of food (e. g. relevance of water vapor permeability), also the films LDPE/LLDPE, BOPP/PP, cPP, OPA/cPP and PET/PVdC/PE can be recommended with reservations.

Final conclusion: In this project, commercially available packaging materials were evaluated in relation to their high pressure useability and possible pressure induced changes of product properties. It was possible to draw up a shortlist for suitable materials.

Economic Value:

Without doubt, the preservation of foods is by far the largest commercial application of high hydrostatic pressure related to biological systems, and the application has steadily increased during the past 10 years. At present, 128 industrial installations exist with volumes from 35 to 420 litres and an annual production volume of more than 200,000 tons. The use of investigated high pressure treatment processes including all different aspects will be an optimal approach to strengthen the market position of SMEs. The knowledge acquired in this project will help the participating SMEs to produce safe food, packed with optimally adapted packaging materials obtained from the different investigations. This is necessary to adapt stringent quality and safety standards for high pressure treatment. The advantage of this project is that the participating companies get the knowledge of the high pressure treatment process which is investigated and optimized all along the different factors of influence as well as economic.

Publications (Choice):

1. FEI-Final Report 2011.
2. Töpfl, S. und Heinz, V.: Unter Druck gesetzt. Fleisch. Tech. 4, 46-2 (2012).
3. Töpfl, S. und Heinz, V.: Haltbarmachung und Strukturbeeinflussung von Fleischwaren. Runds. Fleischhyg. Lebensmittelüberwach. 1, 14-18 (2012).
4. Schmidgall, J., Toepfl, S., Hertel, C., Bindrich, U. und Heinz, V.: Hochdruckbehandlung marinierter Geflügelfleischprodukte - Inaktivierung von Mikroorganismen. Teil A: Verbesserung der Produktsicherheit und Produktionsplanung. Fleischwirt. 5, 109-112 (2011).
5. Schmidgall, J., Toepfl, S., Hertel, C., Bindrich, U. und Heinz, V.: Hochdruckbehandlung marinierter Geflügelfleischprodukte - Sensorische und Rheologische Veränderungen. Teil B: Verbesserung der Produktsicherheit und Produktionsplanung. Fleischwirt. 6, 109-111 (2011).
6. Schmidgall, J., Hertel, C., Bindrich, U., Heinz, V. und Toepfl, S.: High pressure inactivation of relevant target microorganisms in poultry meat products and the evaluation of pressure-induced protein denaturation of marinated poultry under different high pressure treatments. High press. res. 31 (1), 253-264 (2011).
7. Töpfl, S.: Physikalische Technologien zur Haltbarmachung und Strukturbeeinflussung von Fleischwaren. Tagungsband FEI-Jahrestagung 2011, 31-46 (2011).
8. Hein, O., Schmidgall, J., Bolte, S. und Töpfl, S.: Hochdruckbehandlung von Rohmilchcamembert – Inaktivierung von *Listeria innocua* und Einfluss auf funktionelle Eigenschaften. Runds. Fleischhyg. Lebensmittelüberwach. 10, 350-352 (2010).

Further informations:

German Institute of Food Technologies (DIL)
Dr. Volker Heinz/Prof. Dr. Stefan Töpfl
Prof.-von-Klitzing-Str. 7
D-49610 Quakenbrueck
Phone: +49 5431 183-228
Fax: +49 5431 183-200
E-Mail: s.toefl@dil-ev.de

Research Association of the German Food Industry
GFPi/FEI EU-Office
Dr. Jan Jacobi
47-51, Rue du Luxembourg
B-1050 Brussels/Belgium
Tel.: +32 2 2820840
Fax: +32 2 2820841
E-Mail: gfpi-fei@bdp-online.de

Ofi –Austrian Research Instituts for Chemistry and Technology
Dr. Johannes Bergmair
Brehmstraße 14a, A-1110 Vienna/Austria
Phone: +42 1 798 16 01 976
E-Mail: johannes.bergmair@ofl.at

BPI bvba – Belgian Packaging Institute bvba
Leo Goeyens
Zi Research Park 280, B-1731 Zellik/Belgium
Phone: +32 457 54 52 76
E-Mail leo.goeyens@lc-office.be

Itene – Instituto Technologico Logistica (Packaging, Transport and Logistics Research Center)
Carmen Sanchez Reig
Albert Einstein, 1. Parque Technológico
E-46980 Paterna/Spain (Valencia)
Phone: +34 96 390 54 00
E-Mail: itneur@itene.com

FRC – Frederick Research Center
Dr. Michalis Menicou
Filokyprou 7-9, CY-1036 Nicosia/Cyprus
Phone: +357 22 43 83 59
E-Mail: m.menicou@fit.ac.cy

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