Available online at www.sciencedirect.com
SciVerse ScienceDirect
Procedia Food Science 1 (2011) 229 – 234
Procedia Food Science

11th International Congress on Engineering and Food (ICEF11)

# Oxygen scavenging films for food application

Doris Gibis[a,b*], Klaus Rieblinger[a]

[a] *Fraunhofer Institute for Process Engineering and Packaging, Giggenhauserstr. 35, 85354 Freising, Germany*
[b] *Technische Universität München, Chair for Food Packaging Technology, Weihenstephaner Steig 22, 85354 Freising, Germany*

**Abstract**

The presence of oxygen causes deterioration of oxygen-sensitive foodstuffs. This leads to a deterioration of quality characteristics like colour, freshness and organoleptic properties. Due to the strong influence of temperature and exposure to light (photo-induced oxidation processes) this effect especially appears in transparent packaged chilled products (like sausages). Therefore, it is necessary to reduce the oxygen content in the headspace of the package. One possibility is the use of modified atmosphere packaging (MAP). But even at optimised processes the residual oxygen-concentration is up to 0.5 – 2 %. To reduce this destructive oxygen, the additional use of oxygen scavengers becomes more and more attractive. Fraunhofer Institute for Process Engineering and Packaging worked together with industrial partners on an improvement of the kinetics of oxygen scavengers. In the AiF-funded project "Optimisation of transparent packaging materials with iron-based oxygen-scavengers for chilled products" (Nr. 15555N) the kinetics of oxygen-scavengers should be improved. Background of this was that the systems that are already available at the market do not work fast enough at low temperatures (5 °C). Therefore the aim of the project was to incorporate the oxygen scavenger into the packaging material and thus achieving better quality preservation and longer shelf-life of the chilled food. It could be shown that integrating the masterbatch SHELFPLUS® 2500 (SP2500) in a polymer (EVA) with high oxygen permeability resulted in higher oxygen consumption. Comparisons of the oxygen consumption of sausage and film showed that the use of the multilayer film PE/AL(SP2500; EVA) in combination with the food (exposed to light) resulted eight days earlier in a total consumption of the oxygen than storing the sausage without active film. This leads to a certain protection of the sausage.



*Keywords:* oxygen scavenger; active packaging; chilled products; sausage

## 1. Introduction

Many foods like sausages or cheese are very sensitive for oxygen and light. This leads to oxidation reactions with fatty acids and under presence of light also to a destruction of pigments (photo-oxidation),

* Corresponding author. Tel.: +49-8161-491-628; fax: +49-8161-491-666.
*E-mail address*: doris.gibis@ivv.fraunhofer.de.


doi:10.1016/j.profoo.2011.09.036

e.g. nitrosomyoglobin in sausages. Discolouration and rancidity are the consequences that lead to a rejection of the product by the consumer [1]. Therefore the food has to be protected against oxidative changes, preliminary caused by photo-oxidation. This can be achieved by packaging the food in non-transparent packages and under a modified atmosphere (MAP-Modified Atmosphere Packaging). Previous investigations [2] showed that sausages are mainly packaged in an atmosphere with a mixture of $CO_2$ and $N_2$. But even at optimised processes the residual oxygen-concentration is up to 0.5 to 2 %. This is due to oxygen that remains in the headspace after packaging process or due to solved oxygen in the food permeating into the headspace. Under presence of light even these low oxygen concentrations are enough to achieve undesired colour and odour changes. Because of the consumers demand for transparent packages an exclusion of light is not possible. Therefore the rest-oxygen content has to be reduced. A good way might be the use of oxygen scavenger systems [3; 4; 5]. There are already different systems available on the market like iron-based systems for ready-to-serve meals or natrium-sulfit based systems for beverages [3; 4; 5; 6; 7]. But these systems do not work fast enough at low temperatures (5 °C) to effect a protection of the chilled food. Predominantly colour changes are the consequence. Therefore efforts are made to optimise iron-based oxygen-scavenger systems to make them usable for application with chilled foods. The incorporation of the iron and additives in polymers with high oxygen and water vapour permeabilities is a comprising approach.

## 2. Materials & Methods

### *2.1. Production of oxygen scavenger multilayer films*

Oxygen scavenging films (PE/AL(active layer)) were produced at the Fraunhofer Institute on an extrusion facility (Dr. Collin GmbH, Ebersberg, Germany). The oxygen scavenger masterbatches SHELFPLUS® (SP) 2400 and 2500 (now owned by Albis Plastic GmbH, Hamburg, Germany, former owner Ciba® Speciality Chemicals Inc., Switzerland) [8] were used. The masterbatches contain iron powder and different additives and are activated at a relative humidity (RH) above 70 % [9]. Following polymers were used for producing the films: PE, PP and EVA.

Three different active films were produced:

(a) PE (20 μm)/AL(SP 2400; PE) (30 μm)
(b) PE (20 μm)/AL(SP 2500; PP) (30 μm)
(c) PE (20 μm)/AL(SP 2500; EVA) (30 μm)

The active layer (AL) was produced by mixing one mass fraction of the oxygen scavenger masterbatch with one mass fraction of the polymer.

### *2.2. Measurement of the oxygen absorption*

To characterise the oxygen absorption of the oxygen scavenger films measuring cells were used (Figure 1) [10]. The cells were made of stainless steel with two valves to flush the cell with a desired gas. The gas mixture consisted of 0.5 % $O_2$ and 99.95 % $N_2$ (Linde Gas, Germany). Measuring cells had an inner diameter of 9 cm and thus a permeation area of 63.6 $cm^2$. To adjust the oxygen ingress rate the measuring cells were sealed after filling with a high barrier lid film (PET/SiOx/BOPA/PP). To analyse the absorption of the oxygen scavenger, 350 $cm^2$ of the scavenging film (cut in pieces of 5x5 cm) was adhered to an aluminium foil to guarantee an oxygen permeation only by one side (outer side: AL or PE). Then the samples were placed into the measuring cells with 10 ml distilled water to an adjusted relative humidity (RH) of 100 %. Spacers made of PP were used to separate the pieces to allow free access of headspace gas to the surface of the film.

Food samples were taken from freshly produced packages. To analyse the absorption of the sausages 70 g of the food was placed in measuring cells. The samples were cut and put into the measuring cells