

# APPLICATION OF DIFFERENT KINDS OF PACKAGING TO PREVENT GREYING OF A SPECIAL TYPE OF CHILLED SAUSAGES

Doris Gibis<sup>1</sup> and Klaus Rieblinger<sup>1</sup>

<sup>1</sup> Fraunhofer Institute for Process Engineering and Packaging IVV, Freising, Germany

**Abstract** – Chilled sausages react very sensitive to oxygen and light. This results even in presence of small amounts of oxygen, in a strong greying of the sausages. This leads to a rejection by the consumer and therefore to economic losses of the retail. Therefore there is a great need to protect sausages from discolouration (greying). Objective of this study was to investigate different kinds of packaging of a special type of chilled sausages (“Leberkäse”) in order to prevent greying. Investigations showed that sausages stored for three weeks at 5 °C under exclusion of light kept its red colour ( $a^*$ -value:  $8.3 \pm 0.4$ ). Moreover packages with additionally adding an oxygen scavenger label showed a protective effect of the oxygen scavenger system on colour stability of the sausages. In combination with an adapting time of three days in darkness before exposing the packages to light (approx. 1000 lx) this led to a maintenance of the red colour of the sausages ( $a^*$ -value:  $8.3 \pm 0.4$  (week 0);  $8.1 \pm 0.2$  (week 3)). The results of the study showed that packaging sausages in darkness (e.g. in non-transparent packages) or by adding an oxygen scavenger label (in combination with an adapting time) to the package can lead to a protection of the red colour of sausages.

**Key Words** – Discolouration, Oxygen scavenger, Photo-oxidation

## I. INTRODUCTION

The availability of oxygen and light leads to reactions of oxygen with fatty acids and to a destruction of the pigment nitrosomyoglobin (photo-oxidation) in chilled sausages. The prevalent consequence is a discolouration (greying) of the sausage. As this leads to a rejection of the product by the consumer it is very important to protect sausages against greying [1]. Modified atmospheres ( $\text{CO}_2/\text{N}_2$ ) are used to package chilled sausages [2]. But even with optimized packaging processes residual oxygen concentrations up to 2 % remain in the headspace of the package. These amounts are already enough to lead to a greying of

sausages. To prevent photo-oxidative processes and consequently a greying, sausages can be stored in darkness (e.g. in non-transparent packages) or under completely oxygen-free conditions. To achieve this, especially the oxygen solved in the product has to be removed [3].

Former investigations already showed that the application of oxygen-scavenger systems might be a good solution to achieve oxygen-free conditions [4, 5, 6, 7]. In combination with a modified atmosphere this can lead to a preservation of the red colour of chilled sausages.

## II. MATERIALS AND METHODS

A special type of chilled sausages (“Leberkäse”) was packaged under a modified atmosphere with a gas mixture of 0.5 % v/v  $\text{O}_2$  and 99.5 %  $\text{N}_2$  (Linde Gas, Germany). Packages (tray: PE/PP/EVOH, ES-plastic, Germany; lid film: PP, Wipak Walsrode GmbH & Co. KG, Germany) were closed using a traysealer T250 (MULTIVAC, Germany). To some of the packages an iron-based oxygen-scavenger label (O2 CONTROL, Netherlands) was additionally added.

Packages without adding an oxygen scavenger label were stored at 5 °C unexposed (0 lx) or exposed (approx. 1000 lx; 12 hrs/d) to light (using a daylight fluorescent lamp, Osram AG, Germany). Packages containing the oxygen-scavenger label were stored the first three days in darkness (0 lx) before being exposed to light (approx. 1000 lx; 12 hrs/d).

The decrease in oxygen concentration [%] in the headspace of the packages was measured with the measuring device Fibox 3-trace (PreSens Precision Sensing GmbH, Germany).

Changes in the colour of packaged sausages were measured using the colorimeter CM-700d (Konica

Minolta Sensing, Germany). To determine the redness of the sausages the  $a^*$ -value was evaluated.

### III. RESULTS AND DISCUSSION

The effect of different kinds of packaging on greying of a special type of chilled sausages (“Leberkäse”) was investigated. Packages were stored at 5 °C for three weeks. One third of the packages was stored unexposed to light (only filled with sausages), one third was stored exposed to light (approx. 1000 lx; 12 hrs/d; only filled with sausages) and one third was first stored for three days (“adapting time”) unexposed (0 lx) to light and then exposed to light (approx. 1000 lx; 12 hrs/d).

Figure 1 shows the oxygen concentration (%) in the headspace of the packages at three different storage conditions. The oxygen concentration in the headspace of the packages stored unexposed to light (0 lx) showed a slower decrease compared to packages stored exposed to light (approx. 1000 lx). This could be explained by photo-oxidative processes which additionally started when sausages are exposed to light. Moreover the packages with the oxygen scavenger system showed a very fast decrease in oxygen concentration within the first three days of storage (when packages were stored unexposed to light). This resulted in oxygen-free conditions (0 % v/v) within the storage period of three weeks. Following, no reactions of oxygen with the sausage occurred when exposing packages to light. Similar effects were also detected in previous works which investigated residual oxygen contents in modified atmosphere packages (with and without adding an oxygen scavenger) [8].

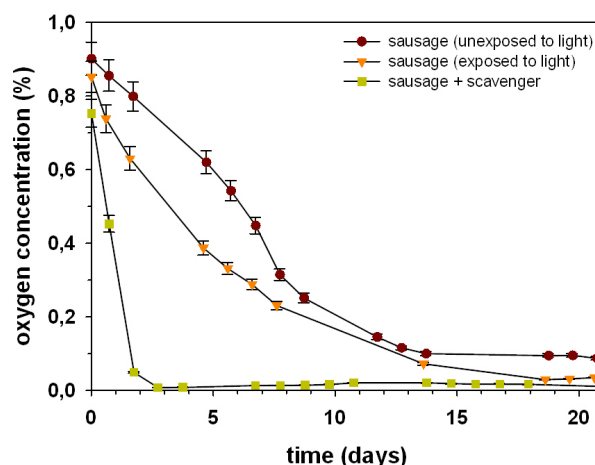


Figure 1. Oxygen concentration (%) in the headspace of packages filled with sausages at different storage conditions; storage temperature: 5 °C [9]

Figure 2 shows the  $a^*$ -value (redness) of sausages stored unexposed to light (0 lx) or exposed to light (approx. 1000 lx). Investigations showed that sausages stored in darkness kept its red colour within a storage period of three weeks (Figure 3). This could be confirmed with no decrease in  $a^*$ -value ( $8.3 \pm 0.4$ ). Sausages stored exposed to light lost its red colour already within one week of storage ( $a^*$ -value:  $0.5 \pm 0.2$ ). This greying of the sausages was induced by photo-oxidative processes which immediately started when exposing packages to light. The results showed that packaging sausages under exclusion of light leads to a maintenance of the redness. This can be achieved by packaging sausages in non-transparent packages.

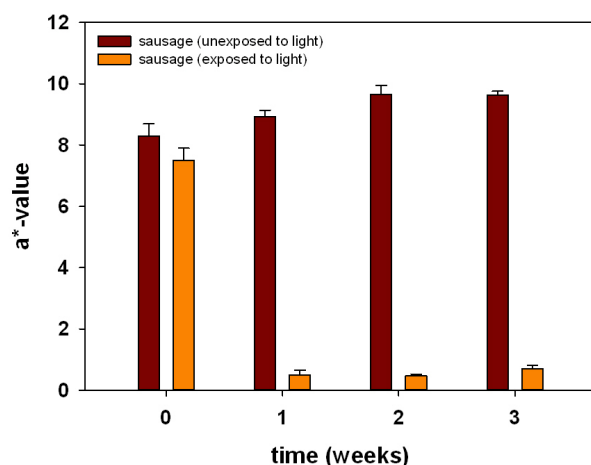


Figure 2.  $a^*$ -value of sausages stored in packages unexposed (0 lx) or exposed (approx. 1000 lx) to light; storage temperature: 5 °C [9]



Figure 3. sausages stored without scavenger unexposed to light (left) or exposed to light (middle) and with scavenger (right) for three weeks; storage temperature: 5 °C [9]

induce photo-oxidative changes after exposing the sausages to light (Figure 1). Previous works also investigated this 'greying' or 'discolouration' of different types of sausages [10, 11, 12].

Following the results of this study showed that storing sausages in modified atmosphere packages in darkness (e.g. in non-transparent packages) or under oxygen-free conditions (using an oxygen scavenger system) led to a maintenance of the redness and consequently to prevent greying of the product.

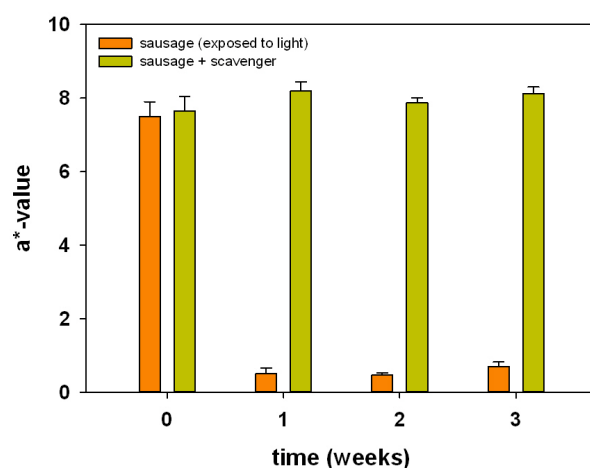


Figure 4.  $a^*$ -value of sausages stored in packages without oxygen scavenger (exposed to light) or with oxygen scavenger (incl. an adapting time of three days in darkness); storage temperature: 5 °C [9]

Figure 4 shows the  $a^*$ -value of sausages stored in packages without oxygen scavenger (exposed to light; approx. 1000 lx) and of sausages stored with the oxygen scavenger label in combination with an adapting time of three days in darkness before exposing packages to light (approx. 1000 lx). Sausages stored exposed to light showed a very fast decrease in  $a^*$ -value (down to  $0.5 \pm 0.2$ ) and following to a strong greying of the sausages. Sausages stored in packages with additionally adding an oxygen scavenger label and in combination with an adapting time of three days in darkness did not show any greying ( $a^*$ -value:  $7.6 \pm 0.4$  (week 0);  $8.1 \pm 0.2$  (week 3)). No greying occurred because no oxygen was available to

#### IV. CONCLUSION

Two different kinds of packaging sausages under different storage conditions were investigated in order to prevent greying of a special type of chilled sausages ("Leberkäse"). Investigations showed that sausages kept its redness when packages were stored in darkness (0 lx). This was confirmed with no decrease in  $a^*$ -value within three weeks of storage ( $a^*$ -value:  $8.3 \pm 0.4$ ). Sausages stored in packages with additionally adding an oxygen scavenger label also showed (in combination with an adapting time of three days in darkness) a retention of the red colour of the sausages within the storage period.

Finally the results of this study showed that greying could be prevented by either storing sausages in non-transparent packages or in packages with additionally adding an oxygen scavenger label (in combination with an adapting time of three days in darkness).

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