A "NEW" PREDICTION-METHOD FOR STORAGE STABILITY OF SLICED FROZEN DRY SAUSAGES USING ULTRA VIOLET (UV) LIGHT

Patrik Kirsch and Albert Fischer
University of Hohenheim, Institute of Food Technology, Department of Meat Technology, D-70599 Stuttgart, Germany

Background

During recent years, the consumption of frozen convenience food products has been steadily increasing. The oxidative stability of these products is often limited by ingredients like dry sausage. It would be very interesting therefore to predict the rancidity of the meat products during the storage time.
Light is known to be an important prooxidant in connection with lipid oxidation [1, 2, 3]. The exposure to light intensifies lipid rancidity through the onset of photo-oxidation. The most pronounced effects of light catalyzed reactions are observed with light of highest quantum energy, i.e. light in the lower wavelengths of the visible spectrum and in the ultra violet (UV) spectrum [4]. Products being exposed to UV-light change their oxidative stability faster. The intensity of light energy for different time periods is used, for example, to oxidise oils or milkfat [5]. These results indicate a significant effect of light exposure on oxidation values.

Objectives

The objective of this study was to establish an easy-to-handle method to predict the oxidative stability of different batches of dry sausages after two days. We therefore compared dry sausages with different amounts of rosemary extract to sausages from the local meat industry.

Methods

Dry sausage production: The initial sausage mixture contained 40% lean frozen pork (approx. 5 % fat), 30% frozen pork back fat and 30% 3 mm minced beef (approx. 5 % fat). Other ingredients and additives were added (g/kg) as follows: NaCl (28.0), $NaNO_2$ (0.05), sodium ascorbate (0.5), sodium glutamate (0.5), white pepper (3.5), dextrose (4.0), lactose (5.0) and starter cultures *L. sakei* + *P. pentosaceus* (0.5). Rosemary (Stabiloton®, Raps, Kulmbach) was added as a natural antioxidant in 3 different concentrations (mg/kg): 100, 200, 300. The mixture was stuffed in 65 mm diameter casings of regenerated collagen (R2, Naturin, Germany) and placed in a ripening chamber under standard conditions including smoke after 2, 3 and 5 days for 30 minutes each time. After reaching 25% weight loss, they were cooled overnight to 5°C and cut in 3 mm slices.
Light-illumination: The slices were arranged on white plates and exposed to ultraviolet light from OSRAM HNS 30W OFR 25*1 (distance 50 cm) with a light intensity of 500 lx in a closed white box.
Storage-conditions: After this illumination, the slices were put in tinplate cans (73/58) and stored at 15°C for 48 hours under air-accelerating conditions. To reach a uniform contact of the slices to the surrounding air in the can, V-formed pieces of high-grade steel wire (Ø 5 mm) were put between the slices.
In order to compare the results of the rapid determination to these of normal storage conditions, the sausages were also stored in the same cans at –20°C for 10 months without an exposure to light.
Furthermore, the test was confirmed by an examination of commercially available dry sausages, which were produced for frozen convenience food products from the local meat industry.
Analysis: The oxygen to be measured was taken out of the can with an applied adhesive rubber with a syringe and injected in an oxygen analyser, a solid cell type oxygen meter using a zirconia system solid electrolyte (LF 700, TORAY).
To detect TBARS, a previously described [6] and modified [7] method was used, values were expressed in mg malondialdehyde/kg dry sausage. Hexanal was measured by gas chromatography based on a combination of 2-butanol-concentration and retention times [8]. All analyses were performed in duplicate.
The analysis of carnosic acid was made by an external laboratory using an HPLC-method.
Sensory evaluation: A taste panel consisting of 10 members described the rancidity using a 10-point scale as follows: not perceived (0-1), slightly perceived (2-3), moderately perceived (4-5), strongly perceived (6-7) and very strongly perceived (8-9). The results shown in Figure 3 present averages of the ratings reported by the panellists.

Results and discussion

The time of UV-illumination is an important factor influencing light-induced oxidation. As a result of this, the content of oxygen decreases over time (Figure 1). The batch containing 300 ppm rosemary extract shows the highest content of oxygen, meaning the lowest oxidation. This effect depends on the concentration of rosemary which has also been found by other authors [9, 10]. The content of the secondary oxidation products, TBARS, is significantly smaller in this batch. It is possible to see a clear distinction between the three batches after two days.
After a five and seven month storage period under air-accelerating conditions for the sliced and frozen dry sausage, the same significant differences of rancidity were found (Figure 2, 3). They also depend on the content of rosemary as expected. The analytical data after UV-illumination and storage period correlate well with the sensory results after the storage period as demonstrated in Figure 3. Therefore the prediction of oxidative stability is confirmed.
In the second part of this work, four samples of dry sausages from the market were first compared after UV-illumination. The batch P1 shows a significantly higher amount of TBARS than the three other sausages, especially after an exposure to light of 90 minutes. These results could also be confirmed after a storage period (non illuminated) of 8 and 10 months for the amounts of TBARS (Figure 4) and oxygen.
The influence of different concentrations of carnosic acid in dry sausages from the market was also found after this short time of 48 hours by our method. As shown in figure 5, sample 2, with the highest concentration of carnosic acid, had the smallest amount of TBARS and a small content of carnosic acid correlated to a high amount of TBARS.

Conclusions

Our study describes a simple and reproducible method for the prediction of storage stability of sliced frozen dry sausages. Two days after the end of ripening it is possible to find differences between unknown batches of dry sausages. The results obtained by this method and the results after a storage period of 5 to 10 months, frozen under air-accelerating conditions, correspond well.

Pertinent literature

1. Andersen H., L. Skibsted (1991). J of Food Sc. 56, 1182-1184
2. Carballo J., M. Cavestany (1991). Meat Sc. 30, 235-244
3. Madsen H. L., B. Sorensen, L. Skibsted (1998). Food Chem. 63, 173-180
4. Bekbölet M. (1990). J of Food Protection 53, 430-440
5. Sattar A., J.M. deMan, J.C.Alexander (1976). Lebensm. Wiss u. Technol. 9, 149-152
6. Tarladgis, B.G., B.M. Watts, M.T. Younathan and L.R. Dungan (1960). J.Am-Oil Chem. Soc.37, 44-48
7. Zipser, M.W. and B.W. Watts (1962). Food Technol. 16, 102
8. Lin J.C.C. and I.J. Jeon (1985). J of Food Sc. 50, 843-846
9. Hirasa K., M. Takemasa (1998). Spice Science and Technology
10. Lee B. J., D. Hendricks, D. Cornforth (1998). J of Food Sc. 63, 394-398

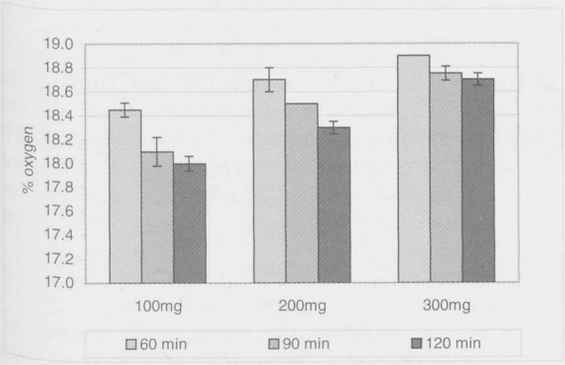

Figure 1: Content of oxygen in cans after UV-illumination and 48 hours

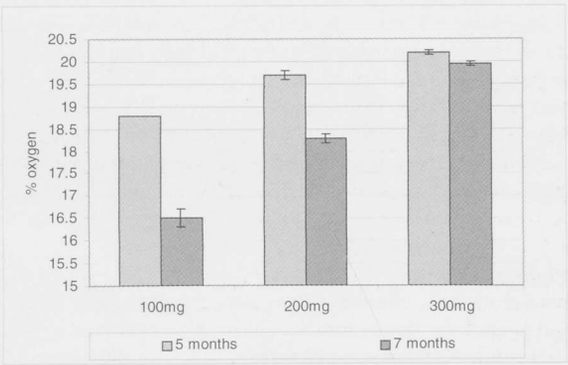

Figure 2: Content of oxygen in cans after frozen storage

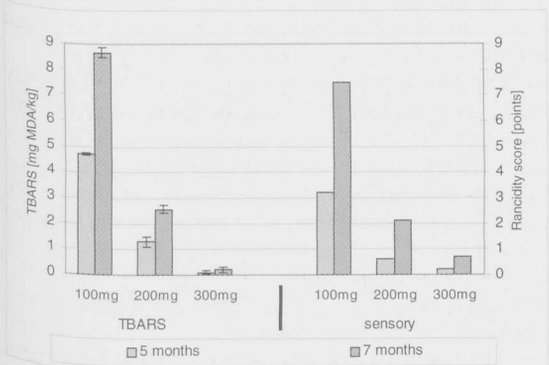

Figure 3: TBARS, sensory after storage

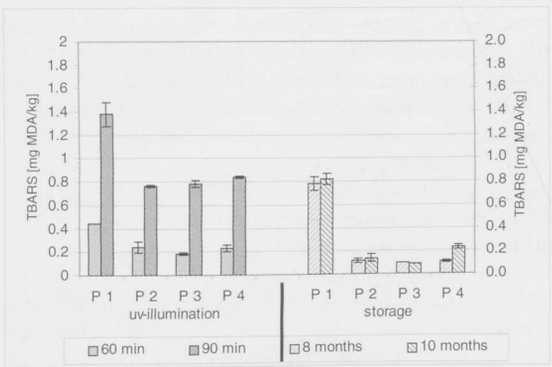

Figure 4: TBARS rapid test compared to storage

sample	carnosic acid [ppm]	TBARS [mg MDA/kg]	Hexanal [mg/kg]
1	63	2.04	2.71
2	112	0.17	1.22
3	50	2.23	3.10
4	71	0.64	2.10

Figure 5: TBARS, Hexanal after UV-illumination compared to carnosic acid