Aspects of an antimicrobial packaging film and its application on food

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Introduction

In order to maintain quality and ensure the safety of packaged food, simple packaging with only a passive barrier layer is no longer sufficient. Retailers and distributors are asking for food products that stay fresh and microbiologically safe for a very long time. Active packaging materials equipped with antimicrobials can increase quality and reduce a potential microbial risk. At the Fraunhofer Institute of Process Engineering and Packaging IVV, Germany, an antimicrobial active film has been developed which is in accordance to the Regulation (EC) 450/2009 on active packaging[1]. The activity of this film is based on sorbic acid. This film releases very low amounts of sorbic acid to the surface of the packaged food. In this way it protects the food at the contact area from microbial contamination.
Objective of the study was to investigate the antimicrobial activity of these films in relation to the migrating amount of sorbic acid.

Methods

For producing this antimicrobial active film, sorbic acid is added to a lacquer and applied on common food packaging films in a lacquering plant. To show the antimicrobial efficacy of the so produced active films the test method ISO 22196:2007[2] was applied using the test-strains *E. coli* ATCC 8739, *S. aureus* ATCC 6538P, *S. cerevisiae* ATCC 18824 and *A. niger* ATCC 6275 (see Figure 1). To investigate the antimicrobial activity of these films on real food systems cream cheese was inoculated with 10^4 spores of *Aspergillus niger*, covered with an antimicrobial film and a reference film without sorbic acid and stored at 8 °C and 25 °C (see Figure 2). The colony count of *A. niger* was performed seven times during the storage period of the cheese. Concurrently with the microbiological tests also migration tests were performed (without inoculation). The amount of migrated sorbic acid was quantified with HPLC-DAD at 260 nm and external calibration.

Results and Discussion

By applying the test method ISO 22196:2007[2] the antimicrobial films showed very high activity with a germ reduction up to 10^6 cfu/object (Figure 1).
Even on real food systems like cream cheese the growth and germination could be inhibited. While at 25 °C the maximal growth of 10^8 cfu/object was reached after 7 days on the reference films, the active films based on sorbic acid were able to reduce the growth completely in this time period. 25 °C is an optimum temperature for the growth of fungi[4].
At 8 °C complete inhibition was reached not until the end of the storage time (21 days), but a steady reduction started after 7 days. The colony count on the uncoated reference film levelled off at 10^4 cfu/object (Figure 3).
This effect of temperature was also observed in the migration experiments. The maximum amount of 4.07 mg/object was determined after 7 days of storage at 25 °C. At the same time only 0.74 mg/object migrated into the cream cheese at 8 °C. At this temperature the maximum (1.10 mg/object) was reached after 14 days of storage, which is approximately four times lower than at 25 °C.

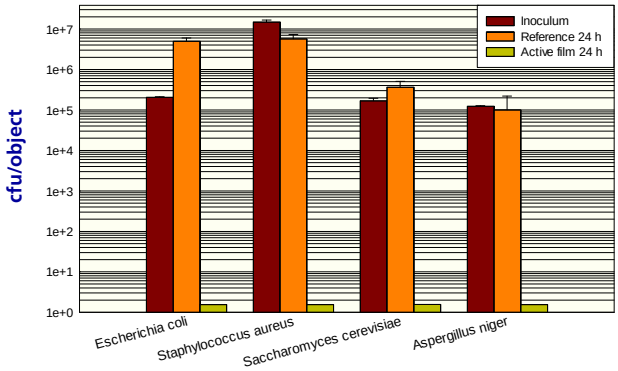

Figure 1: Antimicrobial efficacy of the packaging films according to ISO 22196:2007. Test-strains: *E. coli* ATCC 8739, *S. aureus* ATCC 6538P, *S. cerevisiae* ATCC 18824 and *A. niger* ATCC 6275[3]

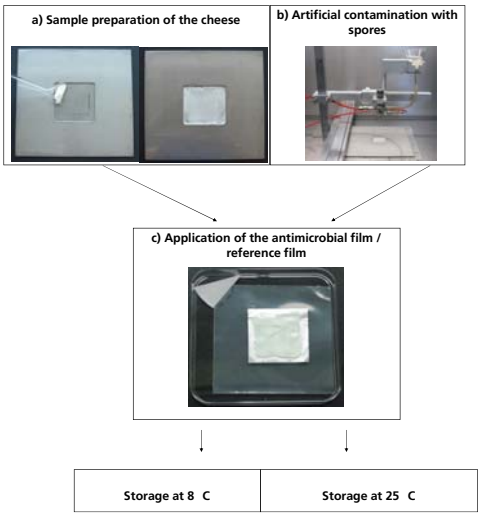

Figure 2: Sample preparation for microbiological tests (a, b and c) and migration tests (a and c) with antimicrobial films[3]

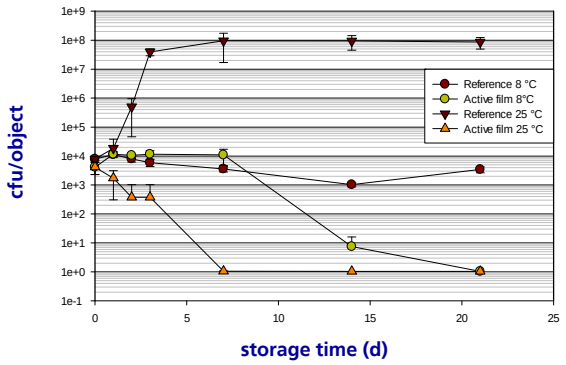

Figure 3: Growth of *A. niger* on inoculated cream cheese covered with antimicrobial films and uncoated reference films at 8 C and 25 C[3]

Conclusion

This study was able to show that this antimicrobial film based on sorbic acid is effective against various microorganisms, such as *E. coli*, *S. aureus, S. cerevisiae* and *A. niger.* It can prevent and even reduce the growth of *Aspergillus niger* on artificially contaminated food surfaces. Its efficacy depends on the migration of sorbic acid, which higher at accelerated storage temperatures. Hence this film can make a significant contribution to the quality and safety of packaged food, especially if there is an interruption in the cold-chain.

References

[1] Commission Regulation (EC) 450/2009 of 29 May 2009 on active and intelligent materials and articles intended to come into contact with food
[2] International Standard ISO 22196:2007; Plastics – Measurement of antibacterial activity on plastic surfaces
[3] Fraunhofer Institute for Process Engineering and Packaging, Freising
[4] Belli, N., Marin, S., Sanchis, V., Ramos, A. J. (2004): *Influence of water activity and temperature on growth of isolates of Aspergillus section Nigri obtained from grapes*. Int. Journal of Food Microbiology 96: 19-27

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