



Tests to achieve longer shelf life of fish

final results and learnings



main goals

- realize a modal shift from road to sea or from air to sea especially for fresh fish (Whole Salmon from Norway to Germany and redfish from Iceland to Germany)
- reduction of the carbon footprint.

technical solutions (tests Deutsche See)

- reefer container with changed atmosphere. (CA Container)
- packaging in boxes with modified atmosphere.

aim of the tests

- achieve longer shelf live of the fish for minimum 5 days to compensate the longer transport time on a ship



Technical solution 1

Fish in boxes wit modified atmosphere

1. picture: sealing machine
2. picture: sealed box



Test partners:

Linde AG

MAP packaging solutions



Technical solution 2

CA container

1. picture: delivery of the CA container
2. picture: fresh fish in the container during a test



Test partners:
Pneumatic Partners
Mar Rubner Institute (MRI)



Test results



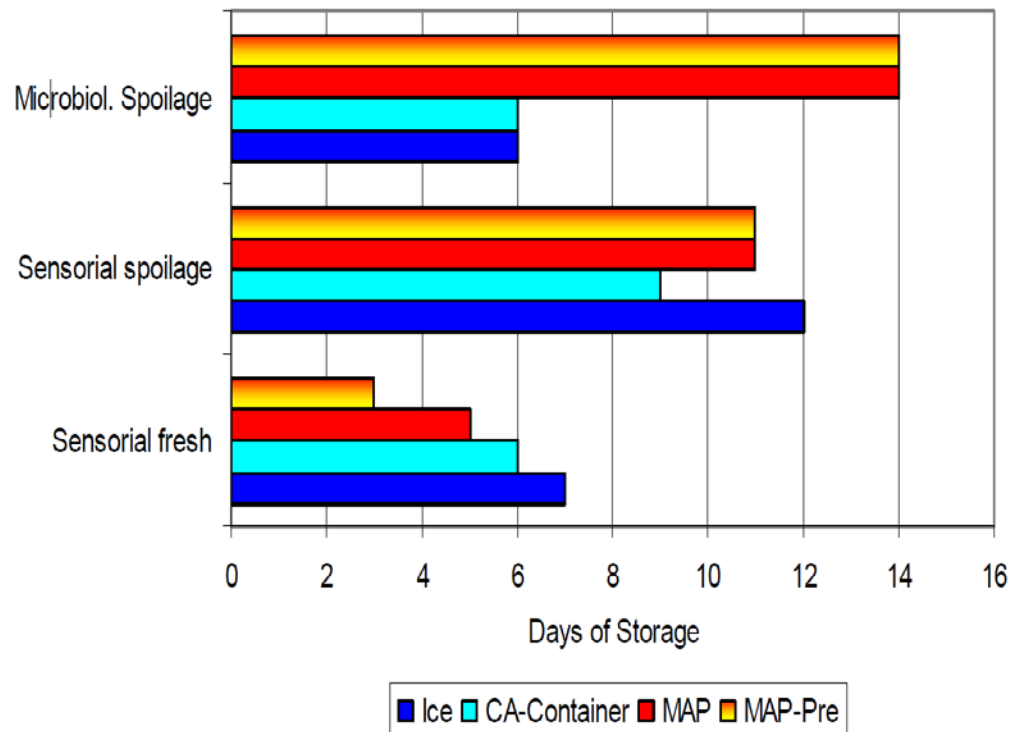
Tests done

general overview

| | Ice | CA-Container | MAP | Map prechilled | Date | result |
|-----------------------|-----|--------------|-----|----------------|---------------|--|
| Salmon | + | + | | | Nov 10 | Transport in a container from Norway to Hamburg. Fish was spoiled when he reaches Hamburg |
| Cod | + | + | | | Nov 10 | Transport in a container from Norway to Hamburg. Fish was spoiled when he reaches Hamburg |
| Salmon | + | | + | | Mrz 11 | under ice spoiles after the 13 th day in MAP packaging spoiled after the 15th day |
| Cod | + | | + | | Mrz 11 | under ice spoiles after the 7 th day in MAP packaging spoiled after the 6 th day |
| Salmon | + | | | + | Jul 11 | shelf life only 2 days longer in MAP packaging |
| Cod | + | | | + | Jul 11 | shelf life only 2 days longer in MAP packaging |
| fish pieces | + | + | + | + | Sep 11 | no relevant difference between the different packaging modes, no longer shelflive achieved |
| redfish | + | + | + | + | Okt 11 | no relevant difference between the different packaging modes, no longer shelflive achieved |
| Salmon fillets | + | + | + | + | Nov 11 | no relevant difference between the different packaging modes, no longer shelflive achieved |
| Whole salmon | + | + | + | + | Feb 12 | no relevant difference between the different packaging modes, no longer shelflive achieved |
| whole redfish | + | + | + | | Okt 12 | Damage of the container test failed |

Results of the test October 11

Redfish - Levels of Acceptability

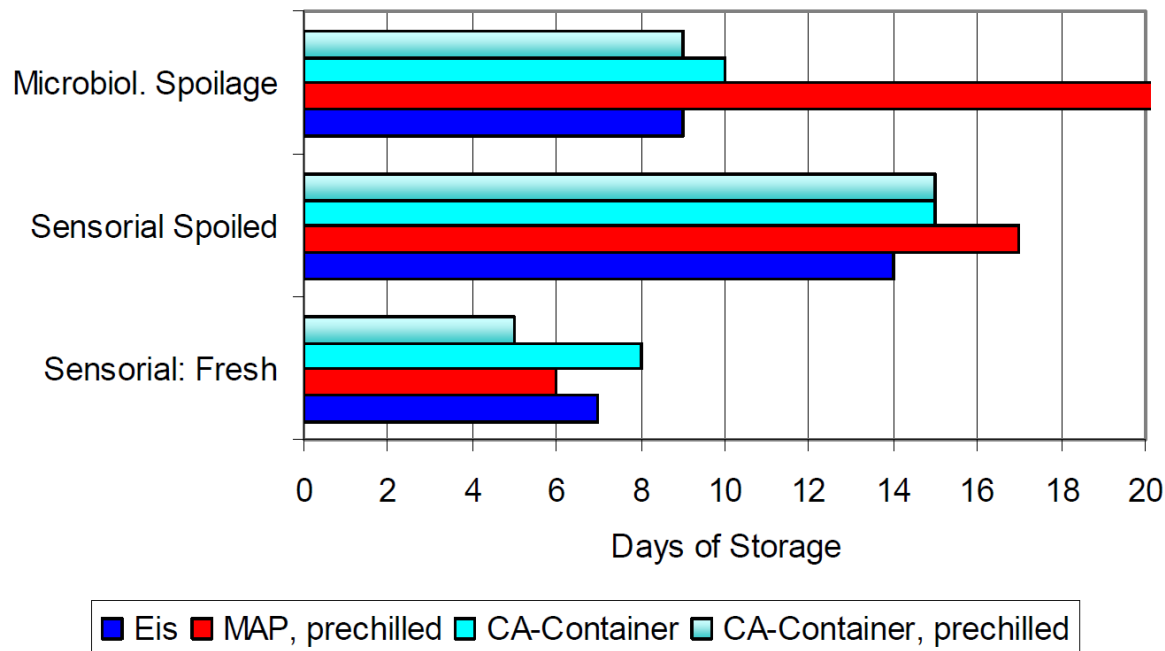


Conclusion

Even if the microbiological spoilage of the fish in MAP packaging is much more better than for the fish under water ice, the important factor ist the sensoric appearance and the freshness of the product. In this case there is no big difference between the different packaging methods.

Results of the test November 11

Salmonfilet: Levels of Acceptability

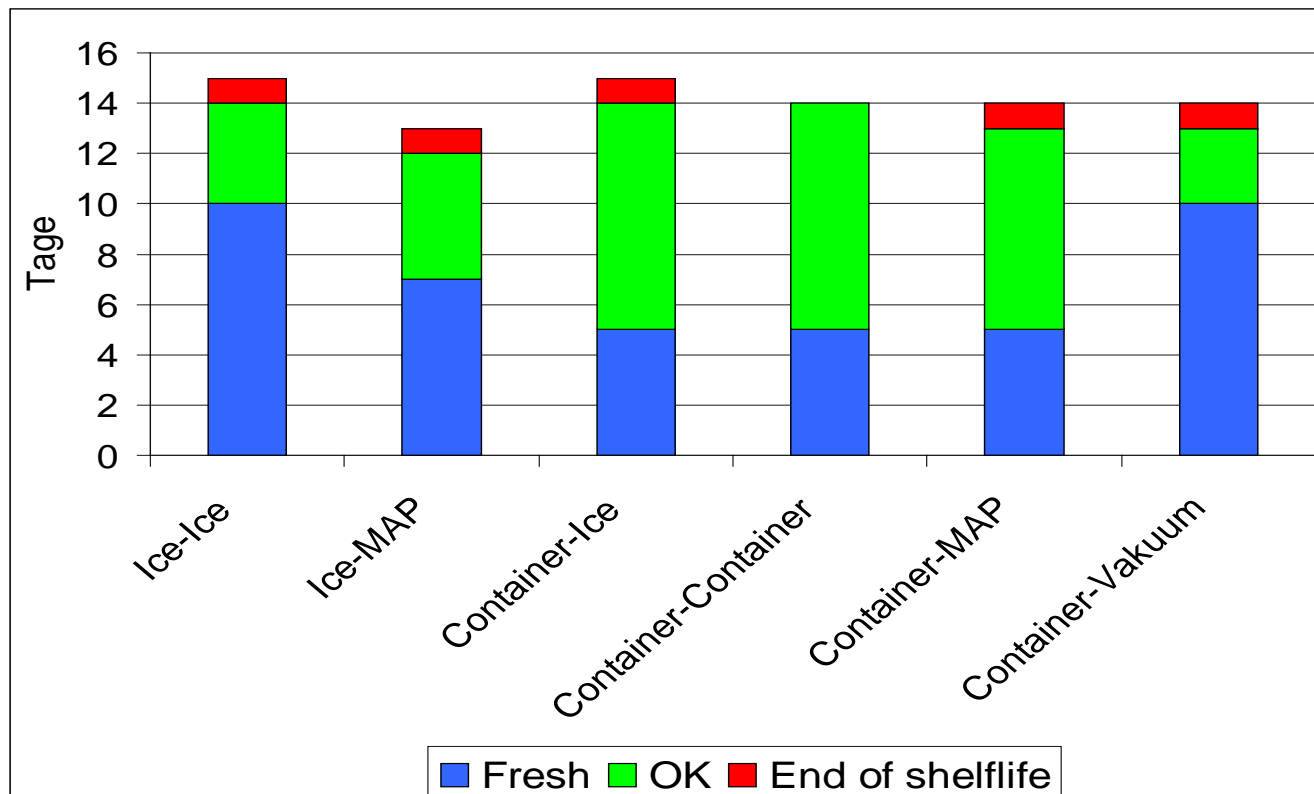


Conclusion

Even if the microbiological spoilage of the fish in MAP packaging is much more better than for the fish under water ice, the important factor ist the sensoric appearance and the freshness of the product. In this case there is no big difference between the different packaging methods.

Results of the last test with Salmon in Febr. 2012

Explanation see next page





Results of the last test with Salmon in Febr. 2012

Conclusion

We can't see any differences between the traditional packing method with water ice and the new technique concerning the CA Container and the MAP packaging.



General conclusion of the tests

**In all our tests we didn't achieve more than 2 days more shelf life.
Never mind which fish species we've tested
So it makes no sense for us to make further tests.
Therefore we've stopped our tests in summer 2013**