Shelf-Life Evaluation of Pork Meat Stored Under Different Packaging Atmospheres

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Context and objective

Modified atmosphere packaging (MAP) with a high level of oxygen is widely used in the fresh meat industry. In fact, high oxygen concentrations preserve the bright red colour of fresh meat and contribute to extend the products shelf-life by reducing microbial growth. The aim of this study was to evaluate the effect of different packaging environments on the microbial quality of fresh pork meat in order to extend its shelf life.

Materials and Methods

Three batches of fresh pork meat were packed under air or under modified atmosphere, and stored at 8°C as shown in Figure 1. The evolution of their natural flora (*Enterobacteriacae,* Lactic acid bacteria (LAB) and *Pseudomonas*) was monitored with time.

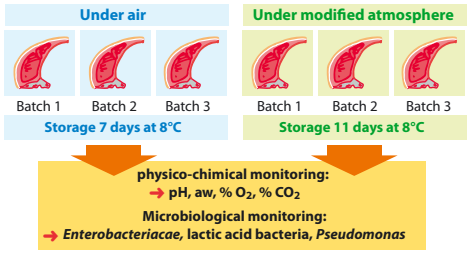

Figure 1: The experimental protocol

The collected data were fitted to the primary model of Rosso (1996) using the software Sym'Previus www.symprevius.net to estimate the growth parameters of the studied flora under both packaging environments. These parameters are: the initial contamination (N_0) and maximum contamination (N_{max}) levels, the maximum growth rate (μ_{max}), and the lag phase (*lag*). Simulations were then performed for several time temperature storage scenarios with the software Sym'Previus (Figure 2).

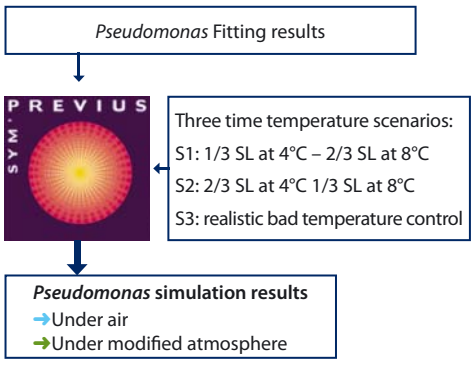

Figure 2: Steps of the simulation process

Results

The fitting results are depicted in Table 1 and show that the lag phase duration (*lag*) varies according to the batch, to the packaging environment and to the flora. As for the growth rates (μ_{max}), they were twice higher under air, compared to those obtained under MAP, for all the studied flora. Moreover, the maximum population densities (N_{max}) observed under air were more important on average than those obtained under MAP for all floras.

Table 1. Growth parameters of spoilage microflora in pork meat

		Under air			Under modified atmosphere		
		Lag (h)	μ_{max} (h^{-1})	N_{max} (log UFC/g)	*Lag* (h)	μ_{max} (h^{-1})	N_{max} (log UFC/g)
Lactic acid bacteria	Batch 1	38 ± 10	0,059	6,55	110 ± 10	0,035	5,54
	Batch 2	19 ± 7	0,056	5,84	96 ± 8	0,032	6,64
	Batch 3	28 ± 9	0,062	6,71	34 ± 11	0,040	5,42
	Mean	**28,33**	**0,059**	**6,37**	**80,00**	**0,036**	**5,87**
	Std dev	**9,50**	**0,003**	**0,46**	**40,45**	**0,004**	**0,67**
Entero-bacteriacae	Batch 1	120 ± 9	0,160	7,56	170 ± 12	0,056	8,36
	Batch 2	100 ± 5	0,120	7,26	130 ± 6	0,053	7,31
	Batch 3	55 ± 9	0,081	7,27	99 ± 10	0,056	6,60
	Mean	**91,67**	**0,120**	**7,36**	**133,00**	**0,055**	**7,42**
	Std dev	**33,29**	**0,040**	**0,17**	**35,59**	**0,002**	**0,89**
Pseudomonas	Batch 1	0 ± 4	0,088	9,49	0 ± 12	0,030	8,88
	Batch 2	4 ± 4	0,089	9,12	0 ± 7	0,035	7,90
	Batch 3	0 ± 3	0,086	8,97	0 ± 6	0,033	7,49
	Mean	**1,33**	**0,088**	**9,19**	**0,00**	**0,033**	**8,09**
	Std dev	**2,31**	**0,002**	**0,27**	-	**0,003**	**0,71**

Based on these results and on the cardinal values, the growth of *Pseudomonas* in the three scenarios S1 to S3 was simulated (Figure 3). For all the studied scenarios, *Pseudomonas* growth was systematically more important under air compared with MAP, which confirms the inhibitory effect of the CO_2 on this spoilage flora.

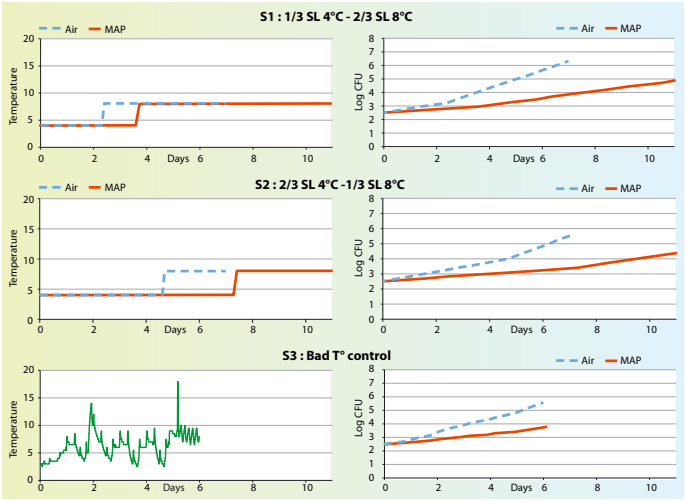

Figure 3: Effects of different storage scenarios on the microbiological quality of meat pork packed under air or MAP.

Conclusion

This study proves that MAP limits the growth of spoilage bacteria and makes a 4 day SL extension acceptable for pork meat with reference to the *Pseudomonas* criterion presented in the French (10^6 CFU/g) GHP guide. Complementary experiments would be useful to predict the behavior of pathogenic micro-organisms in this product for both packaging environments.

References

- *Rosso, L., Bajard, S., Flandrois, et al.(1996) Differential growth of Listeria monocytogenes at 4 and 8°C: consequences for the shelf life of chilled products. J. Food Prot, 59, 944-949*
- *Derens, E., Guilpart, J., Prosen, et al. (2003) La chaîne du froid, du fabricant au consommateur : les résultats de l'audit ANIA. Rapport Ania/Cemagref. 100 p*