THE GROWTH CHARACTERISATION OF *LISTERIA MONOCYTOGENES* IN DIFFERENT MEAT PRODUCTS UNDER VARIOUS CONDITIONS

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Introduction

One of the main objectives of the project was to determine the effects of different storage temperatures and chemical composition of meat products most frequently consumed in Hungary on the growth of *Listeria monocytogenes* using predictive models. The effects of different storage temperatures and packaging technologies (vacuum and modified atmosphere) on the growth of *L. monocytogenes* in Bologna type sausage were also determined by challenge test. Furthermore, the results of challenge tests were also compared with the findings of predictive models.

Materials and Methods

Chemical (salt-, moisture- and nitrite content and pH) and microbiological parameters (TVC, *Listeria monocytogenes*) of 78 pre-packed, sliced and heat-treated meat products from supermarkets and retail shops were determined with standard chemical (AOAC) and microbiological methods (EN ISO 4833, EN ISO 11290-2). The chemical parameter data (Table 1) were used for the growth simulation of *Listeria monocytogenes* with predictive models (http://www.ifr.ac.uk/safety/growthpredictor/).

For challenge tests, *L. monocytogenes* 4ab No. 10 was grown in TGE broth for 24 hours at 37°C, then the cultures were placed in refrigerators at 3, 5, 8 and 10°C for adaptation to lower temperatures. Bologna type sausage was sliced with a Bizerba A 301-type machine and the samples (100-150 g) were aseptically placed in plastic bags. *L. monocytogenes* was inoculated on the surface of sliced Bologna type sausages with an initial *Listeria*-count of about 10^2 CFU/g. The samples were packaged under modified atmosphere and vacuum. The packages were stored at 3, 5, 8 and 10°C and samples in triplicate were taken periodically to determine total viable count and *Listeria*-counts.

Results and Discussion

The microbiological analyses of meat products purchased at retail level (Bologna type sausage, ham, Frankfurter) showed that *L. monocytogenes* was detected in 2 out of 78 samples (peeled Frankfurters).

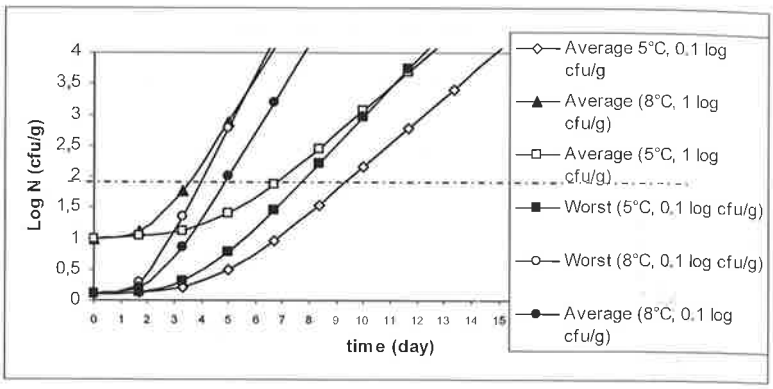
Based on the chemical results (Table 1) the simulation of *L. monocytogenes* (Baranyi and Roberts, 1994) was carried out in Bologna type sausage, in Frankfurter and in ham. Figure 1 shows that with a predicted low inoculum (log 0.1 CFU/g) at 5°C, the time for a 2 fold increase of *L. monocytogenes* is between 3.5-9.5 days in the case of Bologna type sausage.

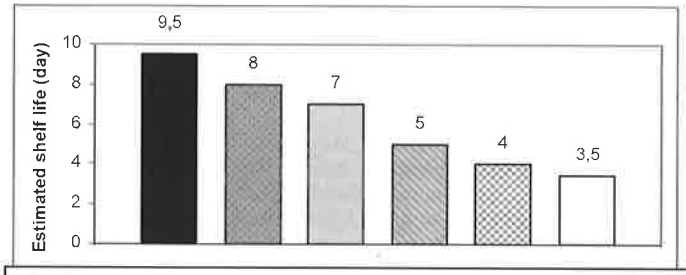
Table 1: Results of chemical analyses.

Product	Bologna type sausage			Ham			Frankfurter		
	Salt%	Nitrite mg/kg	pH	Salt%	Nitrite mg/kg	pH	Salt%	Nitrite mg/kg	pH
Mean	2.17	30	6.27	2.35	21	5.96	2.10	26	6.22
SD	0.26	12	0.2	0.48	24	0.31	0.33	15	0.32
Minimum	1.51	3	5.66	1.36	1	5.10	1.61	2	5.37
Maximum	2.44	54	6.54	2.94	2	6.33	2.91	65	6.69

The effects of different packaging technologies and different storage temperatures on the growth of microflora and *L. monocytogenes* were also determined with challenge tests. Differences were found at 3, 5, 8 and 10°C and between vacuum and modified atmosphere packaging. As expected, at higher temperature the growth was faster (both TVC and *Listeria*) and the modified atmosphere (30:70, CO_2:N_2) inhibited the growth of *L. monocytogenes*.

Figure 1 Simulation of growth of *Listeria monocytogenes* in Bologna type sausage at different temperature composition and initial contamination.





T[°C]	5°C	5°C	5°C	8°C	8°C	8°C
[log CFU/g]	0,1	0,1	1	0,1	0,1	1
composition*	average	worst	average	average	worst	average

*average composition: average compositional condition for *Listeria monocytogenes* to grow: average pH, average nitrite and salt content from Table 1.
worst composition: most favourable compositional condition for *Listeria monocytogenes* to grow: highest pH, lowest nitrite and salt content from Table 1.

Conclusions

We found that the suggested shelf life (when TVC reached 10^6 CFU/g) at 3°C was 41 days in the case of modified atmosphere packages and 28 days in the case of vacuum packages. The shelf life was shorter at 10°C, 6 days in case of vacuum packaging and 19 days in case of modified atmosphere packaging. The modified atmosphere packaging inhibited the growth of *L. monocytogenes* at 3°C for 16 days and at 10°C for 6 days compared with vacuum packaging. There were no differences for 2 log cycles increase of *L. monocytogenes* between the values determined with GrowthPredictor and vacuum-packaging (12-13 days at 3°C and 3 days at 10°C) but significant difference was found at modified atmosphere packaging (the time for 2 log cycle increase of *L. monocytogenes* was 37 days at 3°C and 12 days at 10°C).

Acknowledgements

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References

Baranyi, J., Roberts, T. A. (1994): A dynamic approach to predicting bacterial growth in food. International Journal of Food Microbiology 23, p:277-294.

http://www.ifr.ac.uk/safety/growthpredictor/