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## Prediction of *Listeria* development on meat surface

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thesis of a great number of proteins was enhanced and novel proteins appeared upon stress. Each stress induced a set of specific proteins. However, there were overlaps between these sets of specific proteins. This suggests that those common proteins may be the gene products of common inducible regulating genes in a multigene system of regulation with multiple signals. Furthermore, the same stress induced a certain number of common proteins in 2 different species of *Listeria* (*L. monocytogenes* and *L. innocua*). The most prominent ubiquitous stress protein of *Listeria* had a molecular weight of 17.6 and a pI of 5.1. This protein was found to be induced in every stress investigated and with an induction ratio from 5- to 50-fold depending on the nature of stress. These facts suggest that related or similar bacteria may develop similar (if not the same) strategies (mechanisms) in response to the same stress.

**Prediction of *Listeria* development on meat surface.** JD Daudin, I Desnier, J Labadie, C Laplace, A Lebert (*INRA-Theix, Station de Recherches sur la Viande, 63122 Saint-Genès-Champanelle, France*)

Chilling and storage conditions influence the development of *Listeria* on meat surfaces. The effects of main abiotic factors were studied *in vitro*. *Listeria* strains isolated from meat (43 *L. monocytogenes* and 8 *L. innocua*) were cultured in phosphate-buffered tryptic meat broth (TMB), whose composition is close to that of meat. NaCl was added to adjust the water activity ( $A_W$ ). Growth was followed by optical density (OD) measurements with a photometer using microplates (Bioscreen C, Labsystem, Finland). Each factor (temperature, pH,  $A_W$ ) was tested at 2 levels (low and high) and the number of experiments was reduced by using a Tagushi design. Four conditions were tested: 37°C,  $A_W$  0.96, pH 5.6; 37°C,  $A_W$  1, pH 7.0; 10°C,  $A_W$  0.96, pH 7.0; 10°C

$A_W$  1, pH 5.6. Growth curves were fitted by a Gompertz function:

$$f(t) = A \cdot \exp \left[ - \exp \left[ \frac{\mu e}{A} (L - t) + 1 \right] \right]$$

and growth parameters, lag time ( $L$ ), maximal growth rate ( $\mu$ ) and maximal population level ( $A$ ), were determined. Optical density is related to bacteria concentration, growth curves were expressed as  $\log(\text{OD}/\text{OD}_{\text{at } t=0}) = f(t)$ . The Gompertz function fitted the curves well. The generation time at 10°C was  $13 \pm 3$  h, and the lag time varied from  $17 \pm 7$  h at  $A_W$  1 to  $32 \pm 19$  h at  $A_W$  0.96. The conditions at 10°C are the most disadvantageous and larger differences can be observed between strains. At 37°C, the generation time was  $0.7 \pm 0.1$  h and the lag time was  $0.9 \pm 0.6$  h in the best conditions. When both  $A_W$  and pH were low, the generation time was  $1.7 \pm 0.3$  h and the lag time was  $4.0 \pm 2.1$  h. No correlation was observed between the growth parameters and the strain serotype, *L. innocua* were characterized by higher lag time and maximum population than *L. monocytogenes*. The differences between strains must be considered in the chilling and storage conditions of meat. This study permitted the beginning of a greater project (Usine Ultra-propre) which concerns the testing of more strains and the selection of some of them to study their growth on meat surfaces.

**Factors affecting growth of *Listeria monocytogenes* on fresh, ready-to-use salads.** F Carlin, C Nguyen-The (*INRA, Domaine Saint-Paul, 84143 Montfavet Cedex, France*)

*Listeria monocytogenes* was isolated from fresh, ready-to-use salads with frequencies varying from 0 to 19% (Lainé and Michard, 1988; Velani and Roberts, 1991; Beaufort *et al*, 1992). Concern was expressed that