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IN-LINE NIR SPECTROSCOPY AS A TOOL FOR THE CONTROL OF FERMENTATION PROCESSES IN THE FERMENTED MEATS INDUSTRY

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The research described here was undertaken with the aim of monitoring, optimizing and ultimately controlling the production of heterofermentative microbes used as starters in the salami industry. The use of starter cultures in the fermented meats industry is a well-established technique used to shorten and standardize the ripening process, and to improve and control the organoleptic quality of the final product. Starter cultures are obtained by the submerged cultivation of suitable microorganisms in stirred, and sometimes aerated, fermenters where monitoring of key physiological parameters such as the concentration of biomass, substrates and metabolites suffers from the general lack of real-time measurement techniques applicable to aseptic processes. In this respect, the results of the present work are relevant to all submerged fermentation processes.

Previous work on the application of *on-line* NIR spectroscopy to the lactic acid fermentation (Dosi *et al.* - Monreal NIR1995) had successfully used a system based on a measuring cell included in a circulation loop external to the fermenter. The fluid handling and sterility problems inherent in an external circulation system prompted us to explore the use of an *in-line* system where the NIR probe is immersed in the culture and is thus exposed to the hydrodynamic conditions of the stirred and aerated fluid. Aeration was expected to be a potential source of problems in view of the possible interference of air bubbles with the measurement device. The experimental set-up was based on an *in-situ* sterilizable NIR probe connected to the instrument by means of an optical fiber bundle.

Preliminary work was carried out to identify and control potential interferences with the measurement, in particular the varying hydrodynamic conditions prevailing at the probe tip. We were successful in defining the operating conditions of the fermenter and the geometrical parameters of the probe (flow path, positioning, etc.) were the NIR readings were reliable and reproducible. The system thus defined was then used to construct and validate calibration curves for the concentration of biomass, carbon source and major metabolites of two different microorganisms used as salami starters. Real-time measurement of such parameters coupled with the direct interfacing of the NIR instrument with the PC-based measurement and control system of the fermenter enabled the development of automated strategies for the interactive optimization of the starter production process.