DEPARTMENT OF FOOD SCIENCE
FACULTY OF SCIENCE
UNIVERSITY OF COPENHAGEN

Invitation to PhD defense

Friday 18th of September 2015 at 13:00
Auditorium A2-70.04, Thorvaldsensvej 40, 1958 Frederiksberg C

Title
Metabolic profiling of food protective cultures by *in vitro* NMR spectroscopy

PhD thesis by
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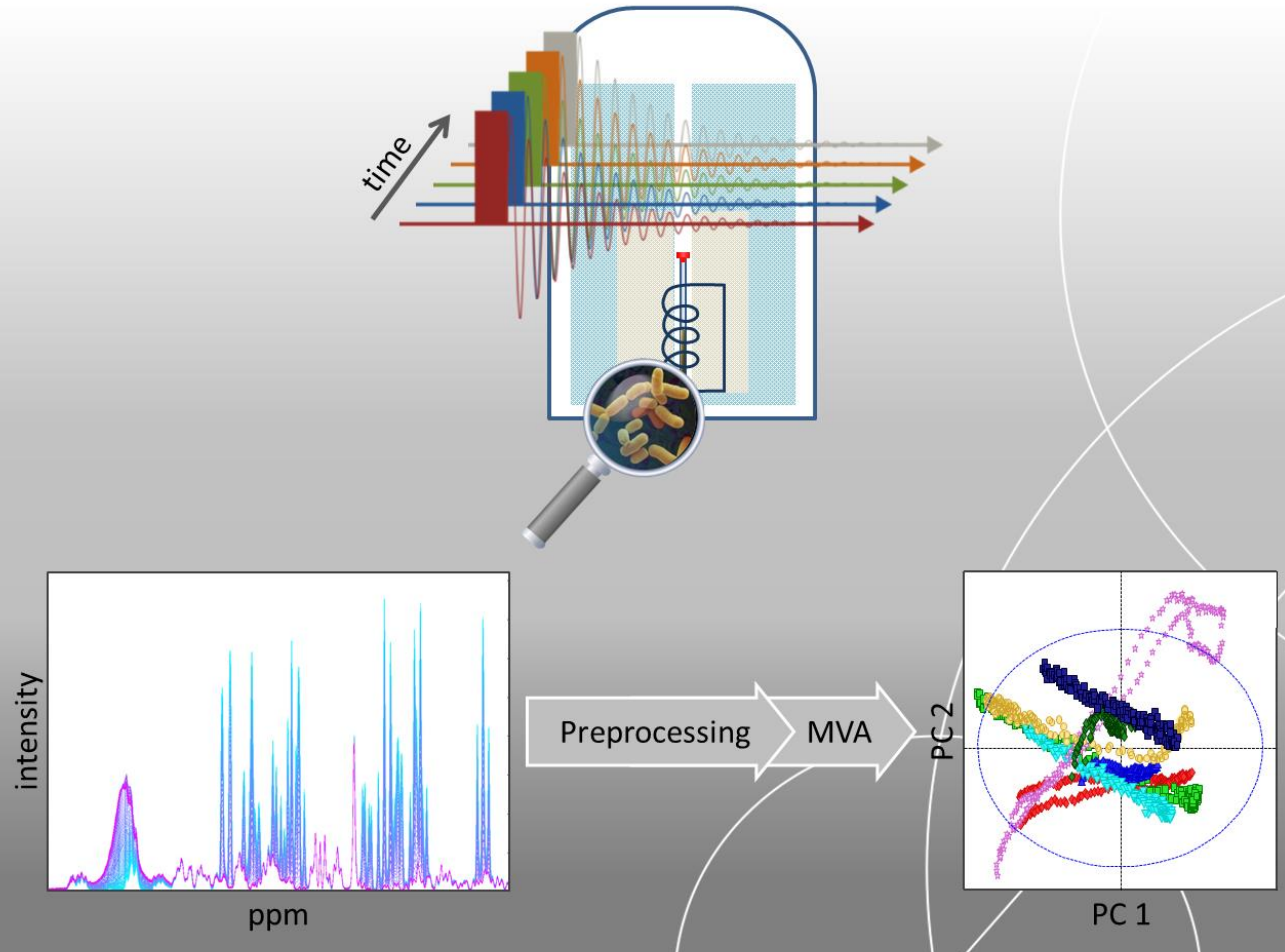

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Abstract

Food spoilage is of major concern to the food industry, because it leads to considerable economic losses, a deteriorated environmental food-print, and to possible public health hazards. In order to limit food spoilage, research on the preservation of food products has always received particular attention by the food industry. Traditionally, such efforts have mainly relied on the application of chemical preservatives or drastic physical treatments. However, chemical preservatives are becoming increasingly unpopular by the consumers, and some have even proven to be toxic and linked to cancer and other health problems. Physical treatments of the products, on the other hand, can deteriorate the sensory properties of the products, and may even destroy some of the nutrients and vitamins. In this context, biopreservation, which is defined as the use of safe antibacterial/antifungal microorganism (so-called protective cultures) has unexploited potential to inhibit the growth of pathogenic microorganisms and enhance the shelf life of the final food product. In order to apply biopreservation in food products effectively, detailed knowledge on the metabolism of protective cultures is required. The present PhD project is mainly focused on the application of *in vitro* NMR spectroscopy for studying the metabolism of protective cultures. As an important part of this work, an analytical protocol was developed for real-time *in vitro* NMR measurements of bacterial fermentation, which includes guidelines from the sample preparation to the data processing and the modelling of the metabolic profiles. The protocol is applied in an experimental design with two strains of lactic acid bacteria. The results highlight some of the metabolic differences between the strains, in terms of nutrients consumption and metabolites kinetics. As a part of this work, an NMR data preprocessing technique, called 'Reference Deconvolution', was employed for the first time to improve the multivariate analysis of the *in vitro* real-time metabolomics data and proved a necessary and elegant solution to the inherent inhomogeneity problem of the samples in the *in vitro* NMR measurements of cells. A second objective of the project was to develop an accurate approach for quantifying mold growth and inhibition. A new method was presented for quantifying mold growth and measuring different segments of mold colonies, based on multispectral images and *k*-means clustering. The method was developed into a software package called 'PCLUSTER', and was demonstrated to be very helpful in two other biopreservation related metabolomic studies. In one case, PCLUSTER was used to quantify how the concentration of diacetyl affects inhibition of the indicator molds and in the second case PCLUSTER served as an efficient tool for quantifying inhibition assays, and finding antifungal metabolites and metabolites that correlated positively/negatively with the inhibition. The developed analytical tools are expected to be very beneficial in the studies related to the biopreservation, and will be used in the future investigations of the protective cultures.