



UNIVERSITÀ DEGLI STUDI DI MILANO

DIPARTIMENTO DI SCIENZE VETERINARIE
PER LA SALUTE, LA PRODUZIONE ANIMALE
E LA SICUREZZA ALIMENTARE



STSM proposal: Dr Valentina Caprarulo

1H NMR spectroscopy technique as a valuable tool in metabolomics studies.

Metabolomics, an “omics” field in systems biology and functional genomics, allow the global assessment of small endogenous metabolites within a biological sample using rapid and high-throughput techniques using a bioinformatics approach (Pan et al., 2013). Metabolomics investigate the multifaceted interactions of metabolites with other metabolites, but also the regulatory role metabolites provide through interaction with genes, transcripts and proteins (Dunn et al., 2011). In this respect, metabolomics examine metabolites as low-molecular-weight compounds in a system, and also has been applied to variety different fields and topics.

The 1H nuclear magnetic resonance (NMR) spectroscopy as an emerging technique, has become an important tool applied in metabolomic investigations. Comparing to the usual spectroscopy, NMR spectroscopy give not only the frequency or wavelength of the observed absorptions, but also give the position of the trace in “ppm” using the chemical shift scale. NMR method benefits from being quantitative, highly reproducible and is a non-destructive technique thereby allowing several analyses to be conducted on the same sample.

Data acquired from NMR analysis are complex and sometimes difficult to analyze. The main goal of metabolomics is to convert raw data into biological knowledge (Dunn et al., 2011). For this reason, a statistical analysis must be conducted; particularly data acquired from NMR analysis can be examine using the Principal Components Analysis (PCA). Principal components analysis is a variable-reduction technique aiming to reduce a larger set of variables into a smaller set of 'artificial' variables, called 'principal components'.

In light of these emerging and important aspects of NMR spectroscopy, it is clear that this technique can be applied to different field. In this respect, the role of micronutrient supplementation and more in general nutrition can modulate the metabolic status of animals. Precisely, several metabolomics studies have been carried out in response to different bioactive molecules or nutrients in order to better understand the metabolism in ruminants, with emphasis to lactating dairy cows. In this respect, my main interest is to investigate different nutritional strategies to better understand and improve the metabolic health of dairy cattle. Specifically, during my Ph.D. I have investigated the role of choline supplementation, in a rumen-protected form (RPC), in dairy cows during the transition period on milk production, metabolic health and hepatic gene expression. These research have been done mainly during my stay at University of Wisconsin (US), where I have addressed the mechanism beyond the metabolic changes induced by the RPC supplementaion, with emphasis on hepatic gluconeogenesis, lipid oxidation and transport, that occur during the transition period. Accordingly, this STSM will represent a further stem in my early stage researcher carrierier, since it will integrate my experetise and skills in the omics techniques. These latter will be essential for work in a project that both instutions involved (university of Milan and Universitat Autnoma de Barcelona) has submitted (selected for the second final step of evaluation) focused on dairy cow nutrition and welfare. The project titled “Rumen protected choline supplementation during the dry period and its effect on the onset of lactation in dairy cows in Southern Europe”, will investigate the effect of choline during the dry period on the metabolic health and performance of multiparous Holstein cows, and NMR spectroscopy will be its main investigative approach. In this contest, the University of Barcelona will collaborate in this project.

The STSM will be a great opportunity not only for improving my skills and learn a new techniques



UNIVERSITÀ DEGLI STUDI DI MILANO

DIPARTIMENTO DI SCIENZE VETERINARIE
PER LA SALUTE, LA PRODUZIONE ANIMALE
E LA SICUREZZA ALIMENTARE



as ¹H nuclear magnetic resonance (NMR) and in bioinformatics, but also for reinforce the collaboration between the two dairy care participating research groups.

The Universitat Autònoma de Barcelona (UAB) is the ideal place to carry out the proposed research study. This is because the UAB possess 8 Bruker NMR spectrometers for analysis or study of any sample and Dr. Ahmed A.K. Salama has an experience in the NMR analysis as proven by his publication record. Therefore, Dr. Caprarulo will greatly benefit from the great expertise of the Ruminant Research Group of the UAB both on the NMR analysis and on both animal physiology and nutrition. Furthermore, the experience acquired will be used in future work at Dr. Caprarulo home university.

The aim of the STSM is also the collaboration between early stage researchers in order to produce when possible joint publications according to COST action aims.

References

Dunn, W. B., Broadhurst, D. I., Atherton, H. J., Goodacre, R., & Griffin, J. L. (2011). Systems level studies of mammalian metabolomes: the roles of mass spectrometry and nuclear magnetic resonance spectroscopy. *Chemical Society Reviews*, 40(1), 387-426.

Pan, X., Smith, F., Cliff, M. T., Capozzi, F., & Mills, E. C. (2014). The application of nutrimentalomics to investigating the bioaccessibility of nutrients in ham using a batch in vitro digestion model. *Food and Nutrition Sciences*, 5(1), 17.