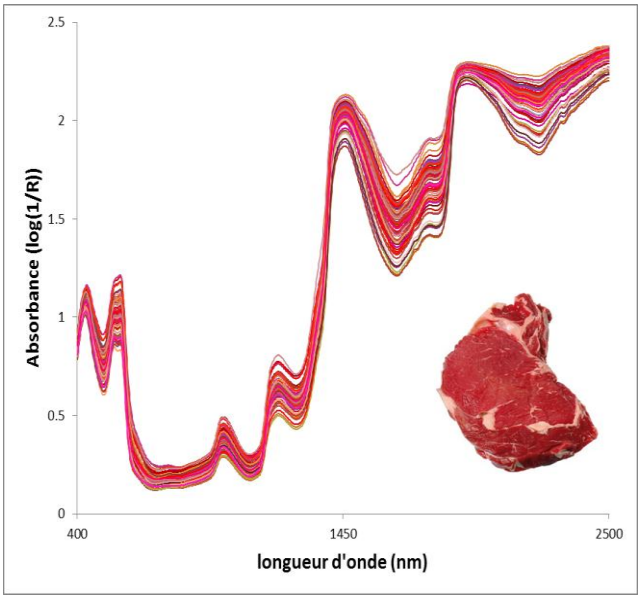
UMR1213 Herbivores

Animal Muscle Meat Team (Amuvi)

Near Infrared Spectrometry coupled to predictive methods: an innovative approach to determine the nutritional composition of beef meat

We propose a new approach to determine the content of beef meat in polyunsaturated fatty acids of strong nutritional interest for human nutrition. This approach, both cheap and easily applicable in slaughterhouses, is based on near-infrared spectroscopy (NIRS) to determine the content in major fatty acids, and on prediction equations to estimate minor fatty acids from major ones determined by NIRS.



The meat industry now takes into account human health, with a goal to increase the content of polyunsaturated fatty acids (PUFA) n-3 in beef meat. At present, the reference method (gas liquid chromatography) to accurately quantify these fatty acids is costly, time consuming and complex. A major challenge for producers and slaughterers is to design tools to determine PUFA quickly and easily in industrial conditions in order to accurately determine the composition of the meat before marketing. This issue is part of the research program Specmeat carried between academic research and industry. The near-infrared spectroscopy (NIRS) is a promising technology. Its implementation requires a calibration step where NIRS absorption spectra are correlated with the values obtained by the reference method. In addition, the performance of NIRS for the quantification of beef PUFA remains very limited (Cechinatto et al., 2012). Therefore, we proposed to use concomitantly NIRS and a statistical predictive method to determine PUFA concentrations.

The results from calibration models of the composition of beef fatty acids obtained by NIRS are in agreement with those found in the literature. Saturated and monounsaturated fatty acids (total and individual) are correctly predicted by NIRS (R^2> 0.89). The determination of PUFA was improved compared to the literature thanks to the wide range of variation in experimental conditions considered (breeds, diets, type of production, type of muscle ...). However, as expected, its remains insufficient (R^2 <0.6). To overcome this weakness of NIRS, prediction equations of PUFA were elaborated by multiple linear regression from fatty acids correctly predicted by NIRS, and information available at the slaughterhouse (sex, type of animals, breeds,…).This work was carried out using databases first from the scientific literature and second from experiments that we conducted over the past 15 years. We were then able to predict accurately total PUFA, total n-6 and n-3 PUFA, C18:2n-6, and C20:4 n-6 (validation R^2 from 0.65 to 0.98). Although the calibration models for the C18:3 n-3 and C20:5 n-3 are correct (R^2> 0.75), the validation of these equations remains unsatisfactory (validation R^2 <0.55).
This work is currently continued to validate the approach (NIRS combined with prediction equations to determine PUFA) on a large number of muscle samples, and to extend it on the whole carcass or even on measurements performed ante mortem.

Publication/patent

Mourot, B. P., Gruffat, D., Durand, D., Chesneau, G., Mairesse, G., Andueza, D. (2015). Breeds and muscle types modulate performance of Near-Infrared Reflectance Spectroscopy to predict the fatty acid composition of bovine meat. Meat Science, 99, 104–112.
Mourot, B. P., Gruffat, D., Durand, D., Chesneau, G., Prache, S., Mairesse, G., & Andueza, D. (2014). New approach to improve the calibration of main fatty acids by near-infrared reflectance spectroscopy in ruminant meat. Animal Production Science, 54, 1848–1852.

Contact : Gruffat Dominique, dominique.gruffat@clermont.inra.fr, Durand Denys, denys.durand@clermont.inra.fr, UMR1213 Herbivores, F-63122 Saint-Genès-Champanelle, France.