NIR DETERMINATION OF MEAT QUALITY CHARACTERISITCS AT DIFFERENT LAMB CARCASS POINTS

G. Fiorentini[1, 2], L. Mur[1], C.A. Fugita[1], L. Bellomo[1], A. I. Negueruela[3], C. Sañudo[1] and MM. Campo[1*]

[1]Dept. Animal Production and Food Science, IA2, University of Zaragoza, C/Miguel Servet, 177, 50013 Zaragoza, Spain.

[2]Faculty of Agrarian and Veterinary Sciences, São Paulo State University, 14884-900, Jaboticabal - SP, Brazil

[3]Dept. Applied Physics, IA2, University of Zaragoza, C/Miguel Servet, 177, 50013 Zaragoza, Spain

*Corresponding author email: marimar@unizar.es

Abstract – The aim of the present work was to evaluate the potential of near infrared spectroscopy to predict the meat quality in different points of collection of the lamb carcass. Prediction of meat quality parameters using NIR spectra as independent variables was explored using the whole sample set (*n* = 100) in four different evaluation points: L1, tail base, C4 and *triceps brachii*. The determination values for pH, toughness, C16:0, C18:0, C18:1 cis-9, C18:2 n-6, Monounsaturated fatty acids, Polyunsaturated fatty acids, fat, protein and moisture in different measurement points were poor (R^2<0.63). The points tested in our study are not indicated to predict the meat quality of the lamb carcass.

Key Words – Carcass traits, chemical composition, fatty acid profile, near infrared spectroscopy

I. INTRODUCTION

The nutritional value is an important contributor to the overall quality of meat. Consumers are increasingly aware of the relationships between diet, health and well-being resulting in choices of foods which are healthier and more nutritious [1]. Typical methods used for meat quality determination are destructive and time-consuming. Moreover, they can be expensive and generate waste products of concern. The use of near infrared spectroscopy (NIRS) is increasing used in food analysis because it offers some advantages over conventional methods giving fast, non-destructive, clean and cost effective measurements. By constructing calibration models between NIRS spectra and chemical or quality tests, the NIRS technique can offer an accurate prediction of some complex quality attributes. More specifically, physic-chemical scores which allows delivery of real-time quality parameters before production is completed. The aim of the present work was to evaluate the potential of near infrared spectroscopy to predict the meat quality in different points of collection of the lamb carcass.

II. MATERIALS AND METHODS

On the day of slaughter, a portable near-infrared LabSpec® spectrometer (350 – 2500 nm, $\Delta\lambda$ = 1nm) was used to measure 4 carcass points in 100 lambs, males and females from Rasa Aragonesa breed: vertebra 1 at lumbar level (L1), the base of the tail, vertebrae 4 at neck level (C4) and surface of muscle *triceps bachii*. 24 h after slaughter, the muscle *longissimus thoracis* was obtained and pH was measured. Texture analysis was performed with a Warner-Bratzler meat shear probe on an INSTRON 4301 in the muscle with 4 days of ageing. The rest of the muscle was kept at -18 ºC until intramuscular fatty acids and proximate analysis were performed [2]. A Partial Least Squared (PLS) regression was used to analyze the data and spectra by means of the software The Unscrambler X (ver. 10.3 CAMO Software AS, Norway).

III. RESULTS AND DISCUSSION

Prediction of pH, toughness, C16:0, C18:0, C18:1 cis-9, C18:2 n-6, MUFA, PUFA, fat, protein and moisture using NIR spectra as independent variables in four different evaluation points (Table 1) were poor (R^2<0.63). . Some studies [3, 4] showed poor modeling results for fat content prediction in intact meat samples. The reason can be attributed to the fact that NIRS spectroscopic method is a point detection technique which can only cover small information of the tested sample, and thus have limitation for non-homogeneous sample, such as intact meat. Additionally, in intact meat samples, the muscle fibers or myofibrils themselves may act as optical fibers tending to conduct NIRS light along their length by a series

of internal reflections, absorbing more energy and giving less reflectance when comparing with homogenized meat, which may lead to poorer modeling results for intact meat samples.

Table 1. PLS cross-validation statistics for determination of meat quality variables in different points of collection of the lamb carcass by near infrared spectroscopy (*n*=100)

	L1		Tail base		C4		Triceps brachii	
	R^2	R^2CV	R^2	R^2CV	R^2	R^2CV	R^2	R^2CV
pH	0.40	0.29	0.31	0.22	0.38	0.28	0.20	0.13
Toughness	0.11	0.06	0.21	0.08	0.05	0.01	0.01	N/A
Palmitic acid (C16:0)	0.02	N/A	0.01	N/A	0.31	0.19	0.18	0.10
Stearic acid (C18:0)	0.31	0.19	0.28	0.15	0.40	0.28	0.16	0.09
Oleic acid (18:1 cis-9)	0.50	0.40	0.49	0.40	0.46	0.37	0.43	0.31
Linoleic acid (C18:2 n-6)	0.40	0.28	0.44	0.34	0.39	0.28	0.31	0.24
Saturated fatty acids	0.28	0.15	0.27	0.11	0.28	0.16	0.25	0.10
Monounsaturated fatty acids	0.63	0.56	0.58	0.51	0.50	0.42	0.48	0.37
Polyunsaturated fatty acids	0.51	0.42	0.52	0.43	0.44	0.35	0.41	0.33
Fat	0.14	0.09	0.03	N/A	0.01	N/A	0.05	0.01
Protein	0.28	0.18	0.04	N/A	0.02	N/A	0.02	N/A
Moisture	0.43	0.33	0.34	0.24	0.41	0.29	0.37	0.21

R^2: Coefficient of determination; R^2CV: Coefficient of determination of the cross validation; N/A: <0.01

Many studies have confirmed the ability of NIRS spectroscopy to predict the chemical components in beef [5]. The majority of studies estimated the prediction accuracy by means of cross-validation using the same sample set previously used for the calibration. However we used a sample set different to that used for the calibration, which probably influenced our results, mainly by the difference in the amount of fat present in the different measuring points. In relation to the prediction of pH value, most studies have found no satisfactory equations for beef, lamb, pork and poultry meat [5]. One of the possible explanations is that scanning the samples after grinding could have reduced the precision of predictions due to a lack of information about the muscle structure i.e. light scattering properties in intact muscle tissue.

IV. CONCLUSION

The points tested in our study are not indicated to predict the meat quality of the lamb carcass.

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