Diet Authentication in Lamb Meat Using Spectroscopic Methods

P. H. M. Dian
INRA, France

D. Andueza
INRA, France

J. Ballet
INRA, France

R. Jailler
INRA, France

M. Jestin
INRA, France

See next page for additional authors

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P. H. M. Dian, D. Andueza, J. Ballet, R. Jailler, M. Jestin, J. Pourrat, I. N. Prado, and S. Prache

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P . H . M . Dian[1] , D . Andueza[1] , J . Ballet[2] , R . Jailler[1] , M . Jestin[1] , J . Pourrat[1] , I . N . prado[3] , S . Prache[1]
[1] INRA , UR1213 Herbivores , Site de Theix , F-63122 Saint-Genès-Champanelle , France ; [2] INRA , UE1153 Monts Dore , Le Roc , F-63210 Orcival ; [3] UEM , Av . Colombo 5790 , 87020-900 , Bloco 32-Sala 3 , Maringá-PR , Brazil
Corresponding author : S . Prache . E-mail : prache@clermont .inra .fr

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Introduction The sensory and nutritional properties of the meat from pasture-fed lambs differ from those of grain-fed lambs . Furthermore , consumers are demanding clear information on the food supplied to animals . It is therefore important to be able to discriminate between products obtained in different production systems , in particular pasture-feeding v . stall-feeding . This study evaluated the potential of three spectral method to discriminate pasture-fed (P) v . stall-fed (S) lamb carcasses : i) quantifying the light absorption in the 450-510 nm area of the visible reflectance spectrum (method 1 , M1) as previously proposed by Prache and Theriez (1999) , ii) using the overall optical information of the visible reflectance spectrum (i .e . between 400-700 nm) (method 2 , M2) , as proposed by Dian et al (2007) and iii) using visible and near infrared spectroscopy (NIRS) between 400 and 2500 nm (method 3 , M3) . The first two methods used a portable spectrophotometer , the latter a non-portable laboratory spectrophotometer .

Materials and methods A total of 259 (120 P and 139 S) Limousine lambs were used . Pasture-fed lambs grazed a permanent pasture that was maintained at a leafy , green vegetative stage , and offered *ad libitum* ; they received no supplementation at pasture . Body weight of P lambs when turning out to pasture and at slaughter was 9 .4 kg (s .d . 2 .23) kg and 33 .3 (s .d . 2 . 91) kg respectively . S lambs were fed indoors on an *ad libitum* diet of commercial concentrate and hay until slaughter at a mean body weight of 33 .9 (s .d . 3 .71) kg . The visible reflectance spectrum of perirenal fat was measured at 24h *post mortem* , with the optical data taken every 10 nm . A sample of perirenal fat was then taken at 24h *post mortem* , packed in aluminum foil , then in a vacuum and stored in a conventional freezer a-20℃ until NIRS analysis . The visible-near infrared spectrum was taken between 400-2500 nm , with the optical data taken every 2 nm . In M1 , the fat reflectance spectrum data were used at wavelengths between 450 and 510 nm to calculate an index quantifying light absorption by carotenoid pigments . In methods 2 and 3 , a multivariate analysis was performed over the full set of fat reflectance data . The raw reflectance spectra of perirenal fat representing the two feeding treatments were submitted to discriminant analysis using the PLS-DA method . Previously , principal component analysis was performed and the mean reflectance spectrum from each feeding treatment was ranked according to the Mahalanobis distance (H) to the average reflectance spectrum in order to detect outliers samples ($H > 3$) . No outliers were found . The models were tested by a cross-validation procedure . The proportion of correctly classified lambs was analysed using the CATMOD procedure of SAS using a two-factor model (feeding treatment and method) with repeated measures on the last factor .

Results and discussion The proportion of correctly classified P lambs was 89 .2 , 90 .8 and 97 .5 for M1 , M2 and M3 ; the performance of M3 was higher than that of M1 and M2 ($P < 0 .01$) , the performance of the latter being not significantly different . The proportion of correctly classified S lambs was 98 .6 , 98 .6 and 97 .8 for M1 , M2 and M3 , these values being not significantly different .

Conclusions M3 yielded a higher proportion of correctly classified lambs compared with M1 and M2 ($P < 0 .001$) . The proportion of correctly classified lambs using M3 was 97 .8% and 97 .5% for stall-fed and pasture-fed lambs respectively .

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