Potential of a low-cost NIR spectrometer and a hyperspectral imaging system for the prediction of the main quality parameters of beef steaks during cold storage

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Introduction: The main parameters influencing consumer's purchasing decision and beef acceptability are colour and general appearance (Faustman & amp; Cassens, 1990). However, freshness and quality thresholds of the meat product might not be clear for all the consumers and they might be rather difficult to estimate using visual evaluation because the meat surface continuously changes during display in retail stores (Prado et al. 2015). The aim of this study was to assess the feasibility of a low-cost NIR spectrometer to estimate the major quality parameters of beef steaks in terms of colour and textural features during cold storage compared with a hyperspectral imaging system.

Material and methods: Twenty-four beef samples from crossbred bulls were collected from the central part of the Longissimus thoracis (LT), corresponding to the last rib level. Instrumental colour (L*, a*, b* values) and pH value were measured directly in all the samples at 24 h post-mortem. Each muscle was cut into four steaks (24x4 = 96), individually packaged in high oxygen modified atmosphere (70% O2:30% CO2) and then displayed for 2, 6, 9 and 12 days in display case conditions with a temperature of 3 ± 0.5 °C and a cycle of 12 h of 900 lx fluorescent lighting and 12 h of darkness. Each day of analysis, instrumental colour and pH were measured. Spectra were acquired at five different random spots using a low-cost near infrared (NIR) spectrometer (SCiO, Consumer Physics Inc., Israel). Samples were also scanned using a hyperspectral imaging system (SpectrononPro, Resonon Inc., USA). Overall acceptability was evaluated by an experienced panellist using a 5-point scale and instrumental texture (Warner-Bratzler shear force test) was determined. Partial least squares regression with internal cross validation was used for developing calibration models and its validation using Matlab® software version R2008 with PLS Toolbox (The Mathworks Inc., USA).

Results and discussion: Results showed a gradual decrease in overall acceptability and red colour during storage period but no significant changes on texture were observed. Overall acceptability, which was correlated to a* values (r = 0.85), can be estimated using the low-cost NIR spectrometer with a R2p of 0.80 and a RMSEP of 0.52. Red colour can also be estimated during storage with a R2p of 0.86 and RMSEP of 0.89. The predictive models using the hyperspectral imaging system were more accurate than the ones developed using the hand-held spectrometer, showing R2p/RMSEP values of 0.83/0.90, 0.92/0.67, 0.84/0.53 for L*, a* and b*, respectively, and of 0.85/0.46 for overall acceptability. This may be due to the acquisition method that integrate better the information of colour heterogeneity of the samples. However, the low cost of such a hand-held device could eventually be used for consumers to make a rapid purchase decision during shopping in retails stores.

Conclusions: The low-cost NIR device can provide information to consumers about beef quality and overall acceptability during purchasing.

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Literature:

Faustman, C., & Cassens, R. G. (1990). The biochemical basis for discoloration in fresh meat: a review. Journal of muscle Foods, 1(3), 217-243.

Prado, I. N., Campo, M. M., Muela, E., Valero, M. V., Catalan, O., Olleta, J. L., & Sañudo, C. (2015). Effects of castration age, protein level and lysine/methionine ratio in the diet on colour, lipid oxidation and meat acceptability of intensively reared Friesian steers. Animal, 9(8), 1423-1430.