Simultaneously Assess Goat Fat Depots using ultrasound technology (RTU) in association with Muliple PLS and ANN Models - A network proposal -

A. Teixeira[1,*], Dias, L.G.[1], Peres, A.M. [1,2],

Abstract

A recent development to improve the prediction of goat body or carcass composition in small has been made. With the perspective to use a unique model to estimate body composition, based on a reduced number of predictors a model using artificial neural networks was proposed. On this sense the main objective of the present work will be to demonstrate the necessity to organize a world network to build a great database, covering the most relevant carcass and body compositions data, for the most important goat breeds at different maturity degrees and with carcasses that proportionate the development of general, robust, and more reliable models to swiftly assess goat and carcass body compositions, as well as to implement a modern and objective on-line technique for carcass evaluation and marketing classification.

Introduction

Recent developments to improve the estimation of body or carcass composition in small ruminants using ultrasound technology (RTU) have been made (Silva, et al., 2006; Hopkins et al., 2007; Teixeira et al., 2008). Particularly for goats, the work of Teixeira et al. (2008) provides suitable multiple linear regression models (MRLM) to estimate, separately, muscle and goat fat depots. However, recently, some practical drawbacks have been pointed out (Peres et al., 2010): (i) one MRL model was required to estimate each carcass content; (ii) in total, five ultrasound measurements had to be recorded, which is not practical to implement in the field; (iii) some dependent or independent variables or both had to be transformed using a

[1] CIMO - Centro de Investigação da Montanha, Escola Superior Agrária de Bragança, Instituto Politécnico de Bragança, Portugal. E-mail: teixeira@ipb.pt
[2] Laboratório de Engenharia da Reacção e Separação, Escola Superior Agrária de Bragança, Instituto Politécnico de Bragança, Portugal

logarithmic scale; and (iv) no data were used to validate the proposed models.

Material and Methods

With the perspective to overcome these problems Peres et al. (2010) have established an unique linear/non-linear multiple model to estimate and predict simultaneously seven goat fat depots based on a reduced number of predictors (goat body weights, BW, and two ultrasonic measures: lumbar subcutaneous fat between fifth and sixth vertebrae, UL5-6FD, and the fat depth at third sternebra, US3FD), using the database published by Teixeira et al. (2008). So, one multiple partial least squares model (PLS) and one multiple radial basis function artificial neural network model (RBF-ANN) were established to simultaneously predict subcutaneous fat, intermuscular fat, kidney and pelvic fat depots, omental fat depots, mesenteric fat depots, total carcass fat and total body fat.

Results and discussion

In the first, the determination of the significant PLS principal components (model dimensions) was made by cross-verification, using a leave-one-out methodology. For the latter model, three layers (Figure 1) were used: an input layer, with three neurons (one for each independent variable), a hidden layer of with six neurons, and finally the output layer with a fixed number of neurons equal to the number of dependent variables studied (seven neurons corresponding to the goat fat depots).
Both multiple models were validated using internal and external procedures, which constitutes a major advantage since the MLR models (correlation models) previously reported in the literature were not validated. Both PLS and RBF-ANN multiple models were able to estimate the seven goat depot data with good accuracy ($R2 \geq 0.72$ and 0.81, respectively) as well as to predict the same fat depots of goats that were not used for establishing the above-mentioned models ($R2 \geq 0.91$ and 0.84, respectively) for gave satisfactory results. Accordingly, the methodologies (RTU with PLS2 or RBF-ANN2 models) proposed by Peres et al. (2010) can be used as an effective practical tool to predict goat carcass fat depots allowing estimating meat yields.

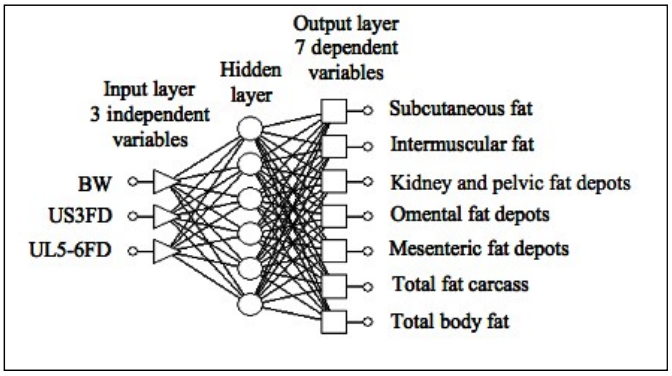

Figure 1 – Diagram of the structure of the RBF-ANN2 model established by Peres et al. (2010).

Conclusions

As a conclusion, it can be pointed out that the use of rapid and accurate methodologies to predict body or carcass composition of live animals and to assess objectively the carcass quality has been and still is a great challenge. For producers as well as for retailers, processors and consumers the knowledge of tissue composition and distribution, the partitioning of fat and muscle units has become more and more important. In our understanding, electronic technology such as RTU together with PLS or ANN techniques may improve the precision of predictions and contribute to implement objective methods that are able to assess body or carcass composition allowing the monitoring of an on-line evaluation system of goat carcass and meat quality. On this sense the main objective of the present work will be to demonstrate the necessity to organize a world network to build a great database, covering the most relevant carcass and body compositions data, for the most important goat breeds at different maturity degrees and with carcasses that proportionate the development of general, robust, and more reliable models to swiftly assess goat and carcass body compositions, as well as to implement a modern and objective on-line technique for carcass evaluation and marketing classification.

References

Hopkins, D.L., Stanley, D.F., Ponnampalan, N.E. (2007). Relationship between real-time ultrasound and carcass measures and composition in heavy sheep. Aust. J. Exp. Agric., 47:1304–1308.

Silva, S.R., Afonso, J.J., Santos, V.A., Monteiro, A., Guedes, C.M., Azevedo, J.M.T., Dias-da-Silva, A. (2006). In vivo estimation of sheep carcass composition using real-time ultrasound with two probes of 5 and 7.5 MHz and image analysis. J. Anim. Sci., 84:3433–3439.

Teixeira, A., Joy, M., Delfa, R. (2008). In vivo estimation of goat carcass composition and body fat partition by real-time ultrasonography. J. Anim. Sci., 86:2369–2376.

Peres, A.M., Dias, L.G., Joy, M., Teixeira, A. (2010). Assessment of goat carcass fat composition using ultrasound technology and multiple multivariate prediction models. J. Anim. Sci., 88:572-580.