

Optimizing the configuration of MRI acquisition in a low-field scanner for fresh loin

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ABSTRACT

Traditional techniques to determine quality traits of the meat products are tedious, time and solvent consuming and require the destruction of the meat piece. As an alternative, MRI has been proposed, since, it is non-invasive, non-intrusive, no-ionizing, innocuous and non-destructive. The procedure of meat product analysis by MRI in order to determine quality traits is based on three main steps: i) image acquisition, ii) image analysis and iii) data analysis. This study focuses on optimizing the image acquisition. The influence of echo time (TE) and repetition time (TR) on prediction results was analyzed by response surface methodology. TE does not significantly affect accuracy of prediction of moisture and lipids of loins, but TR does, finding higher correlation coefficients as TR increases. Besides, statistical results have shown that TE significantly influence on correlation coefficients of moisture ($p=0.01238$) and lipid content ($p=0.04554$), while TR does not affect. Most TR-TE combinations used in this study could be used with accuracy, but TR=26 ms and TE=910 ms could be indicated as the optimum one. Experimental and prediction results showed comparable values for moisture (0.9163 and 0.9177, respectively) and lipid content (0.8466 and 0.8437, respectively), which indicates the accuracy of the methodology based on MRI-Computer vision.

OBJECTIVES

The aim of this work is the optimization on terms of echo time (TE) and repetition time (TR) of the MRI acquisition of loin by using a low-field MRI scanner in order to predict the moisture and the lipid content of this food in a non-destructive and effective way with the highest degree of accuracy.

MATERIAL AND METHODS



IMAGE ACQUISITION

- ESAOTE VET-MR E-SCAN XQ 0.18 T
- HAND/WRIST COIL.
- SPIN ECHO WEIGHTED ON T1
- FIELD OF VIEW: 150 x 150 mm²
- SLICE THICKNESS: 4 mm
- MATRIX SIZE: 256 x 204
- SLICES PER ACQUISITION: 29.
- NUMBER OF IMAGES: 435.

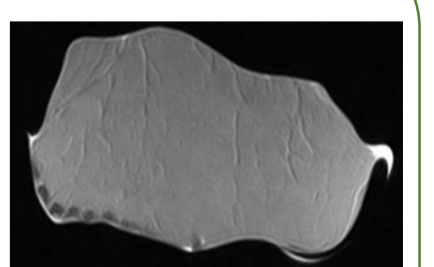


PHYSICO-CHEMICAL ANALYSES

- MOISTURE [1]
- LIPID CONTENT [2]

COMPUTER VISION ALGORITHMS

- GLCM [3]



CORRELATION COEFFICIENTS

OPTIMIZATION TE AND TR

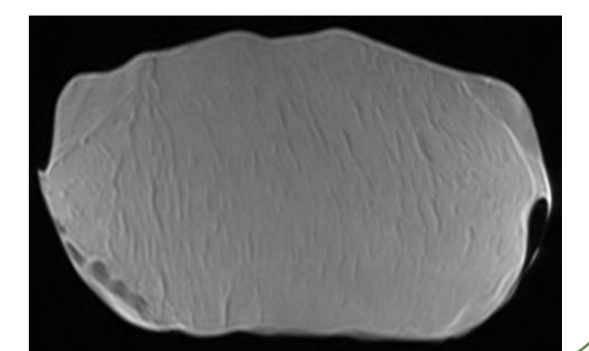
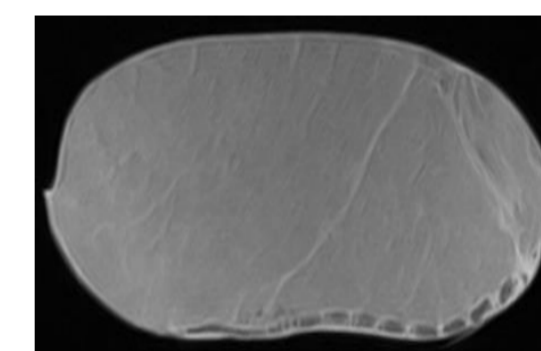
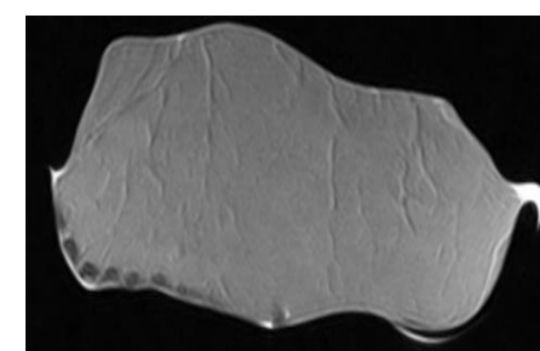
ECHO TIME (TE)

18-26 ms

RESPONSE SURFACE METHODOLOGY

REPETITION TIME (TR)

630-910 ms



RESULTS AND DISCUSSION

Table 1. Correlation coefficient (R) of prediction equations of moisture and lipid content achieved with different TE-TR combinations.

TE	TR	MOISTURE	LIPIDS CONTENT
18	630	0.7978	0.7974
18	770	0.7552	0.7194
18	910	0.8128	0.7418
22	630	0.8268	0.8047
22	770	0.7321	0.7279
22	770	0.8068	0.7823
22	770	0.7913	0.7517
22	770	0.8449	0.8465
22	770	0.8566	0.8703
22	910	0.8377	0.7610
26	630	0.8761	0.8482
26	770	0.8791	0.8387
26	910	0.9163	0.8466

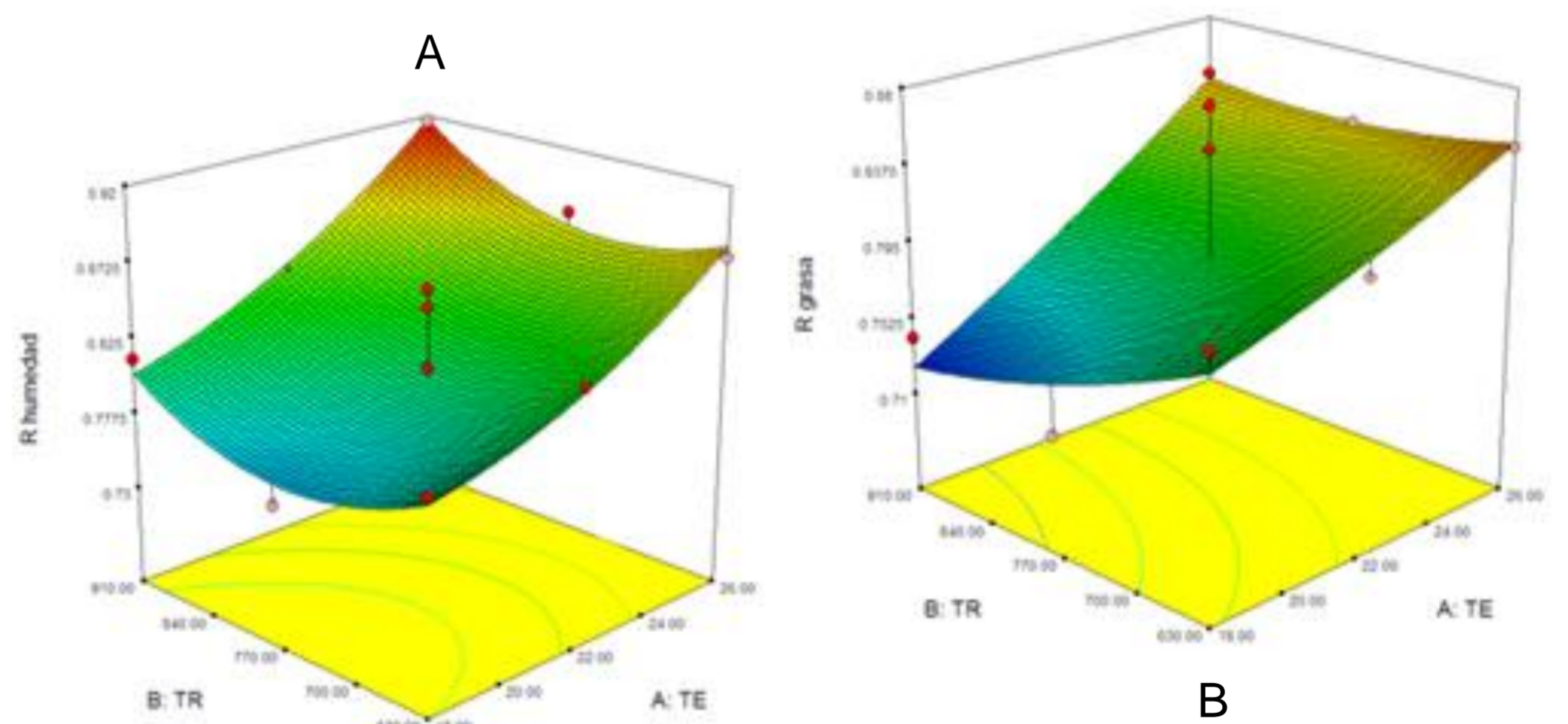


Figure 1. Response surface plots on correlation coefficient of prediction equations of moisture (A) and lipid content (B) as affected by MRI acquisition parameters (TE and TR).

CONCLUSIONS

This study firstly optimizes the MRI acquisition of fresh loin by using a low-field scanner to achieve the best prediction results. TR significantly influences accuracy of prediction of moisture and lipids content of fresh loins, but not TE. Although, a number of TR-TE combinations could be used, TR=26 ms and TE=910 ms could be indicated as the optimum one.

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ACKNOWLEDGMENTS

Daniel Caballero thanks the "Junta de Extremadura" for the post-doctoral grant (PO17017). The authors wish to acknowledge the funding received for this research from both the "Junta de Extremadura" (Regional Government Board - Research Project IB16089; Consejería de Economía e Infraestructuras - economic support for research group GRU15173 and GRU15113) and the funding received from the FEDER-MICCIN Infrastructure Research Project (UNEX-10-1E-402). The authors also thank to "Animal Source Foodstuffs Innovation Services" (SiPA).