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A preliminary study on the feasibility of using microwave frequencies to determine several tissue samples from horses

Raspa F[1], Valle E[1], Bergero D[1], Addamo G[2], Paonessa F[2], Virone G[2]
[1]Department of Veterinary Science, University of Turin, Italy; [2] CNR-IEIIT, Institute of Electronics, Computer and Telecommunication Engineering, Turin, Italy. e-mail: federica.raspa@unito.it

Introduction. The Body Condition Score (BCS) is an important tool for the evaluation of the horse's nutritional status during the welfare assessment. However, its main limitation is its subjective nature [1]. This problem could be overcome with the use of objective techniques. Microwave human body imaging technique is applied to analyse reflections from skin, fat and muscle tissue borders. The aims of the present study are: (i) to obtain preliminary results on the feasibility of the use of microwave frequencies on different *ex vivo* horse tissue samples; (ii) to distinguish the complex permittivity of different horse tissues.

Animals, material and methods. The caudal left thoracic region of a warmblood horse died for other medical reasons was sampled. An open-ended coaxial probe measuring system [2] was used on the following samples: cutaneous and subcutaneous tissue, fat, muscle, and ribs. Such a probe resembles a miniaturized electromagnetic antenna that is placed in close contact with the tissue samples. For each sample, the reflection coefficient (reflected power and time delay) at the open-end is measured at several frequencies covering the band of 0.05-20 GHz. The complex permittivity is then computed from these data. Before the trial, water, air and metal were used for the calibration process.

Results and discussion. Tissue heterogeneity was visible in the present study: each tissue sample revealed its own permittivity value; especially the difference between fat and muscle was very clear (Figure 1). The open-ended coaxial probe measuring system is largely applied in human medicine, showing a non-homogeneous nature of the biological tissues in terms of permittivity [2].

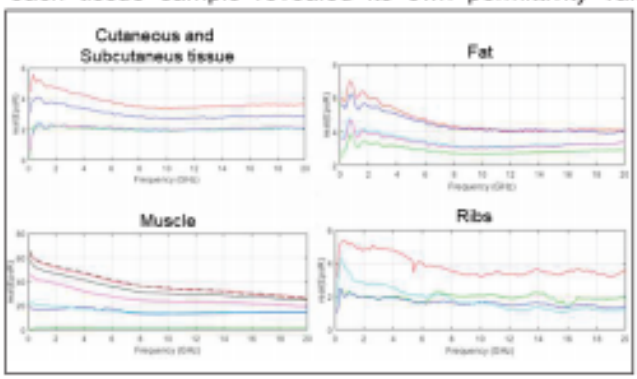

Figure 1. The measured permittivity of the horse's tissue samples (*ex vivo*).

Conclusion. It is the first time that this technique is applied to the horse body part. A layer representative of the horse skin, fat, muscle and bone is simulated, to identify their potential to transmit microwave frequencies in the R-band. The identification of a clear non-homogeneous nature of the biological tissues in terms of permittivity encourage further investigation on this technique. The feasibility of distinguishing the fat tissue from the other tissues (muscle in particular) could be the first step for the future development of a tool that potentially may be usefull for *in vivo* tissue characterization.

References: [1] Quaresma et al. (2013) Vet. J. 197: 329-334; [2] Kuhn et al. (2010) In Proceedings of the 2010 IEEE Radio and Wireless Symposium (RWS) pp. 512-515.