ELECTRICAL MEASUREMENTS AS ON-LINE MEAT QUALITY INDICATORS

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OBJECTIVES

Recent work has determined that a relationship exists between the rate of pH fall, conductivity and impedance measurements taken within hours *postmortem* (Byrne and Troy, 1996). Since previous work has determined that a relationship also exists between the rate of pH decline meat quality attributes (O'Halloran *et al.*, 1995), this work examined the use of electrical measurements to predict meat quality at the *postmortem* period.

BACKGROUND

Variability in the quality of meat has long been the concern of the consumer and recent surveys have shown that consumers have difficulty selecting beef because they are unsure of the quality, particularly the tenderness (Dransfield, 1994). Inferior quality meat is not discriminated against by consumers, it also causes processing problems. These difficulties would be reduced if carcasses showing inferior qual could be identified on the slaughterline, enabling them to be handled and marketed separately from high quality carcasses. Muscle has certa electrical characteristics such as impedance, conductivity and capacitance and according to Warriss *et al.* (1991), these change with t *postmortem* and may be used to predict meat quality. Since the 1930s, various workers have related these characteristics to meat quality but o only recently that instruments have become commercially available which exploit these relationships to predict quality on the slaughterli (Bendall and Swatland, 1988). The relationships between the electrical characteristics and indices of quality are complex and there disagreement as to whether, and how soon after slaughter they can reliably differentiate between meat of normal and inferior quality (Warriss *al.*, 1991).

EXPERIMENTAL METHODS

Heifers (n=47) of similar age, size and grade, were slaughtered and hung conventionally. The right hand side *longissimus dorsi* (LD) muscle were used for all measurements and sampling. pH (Orion pH meter and combined electrode) and temperature (Grant Squirrel data logge measurements (May *et al.*, 1992) were taken at intervals up to 24 hours *postmortem*. Impedance (Meatcheck 160, Sigma Electronic, Germany) conductivity (Pork Quality Meter (PQM) Intek, Germany) and capacitance (Auto LCR Analyser) measurements were also taken at hour intervals up to 8 hours and again at 1, 2, 7 and 14 days *postmortem*. The LD muscle was excised at 24 hours and samples (2.5cm thick) we taken for Warner Bratzler shear force (WBSF) measured with a Universal Instron testing machine (Shackelford *et al.*, 1991), cookl determination, sensory analysis (American Meat Science Association Guidelines (AMSA) 1978) and colour measurement (Strange *et al.* 19 at 2, 7 and 14 days *postmortem*. Driploss determination was carried out at 2 days *postmortem*.

RESULTS AND DISCUSSION

Impedance (I) values decrease with ageing from an average value of 75.0 dimensionless units at 7 hours *postmortem* to 4.8 at 14 da *postmortem* as shown in figure 1. Simple correlation coefficients were calculated for electrical impedance with the quality characteristic measured eg.WBSF, drip loss, cookloss, Hunter Lab colour values and the sensory attributes of tenderness, juiciness, flavour, texture and overa acceptability. Few significant correlations were obtained for electrical impedance. Some correlations, typical of those obtained are given (tab 1). Conductivity (C) values increase with ageing from an average value of 11.13mS\cm at 7 hours *postmortem* to 14.26mS\cm at 14 da *postmortem* as shown in figure 1. Simple correlation coefficients were calculated for conductivity ; very few significant correlations were fou (table 2). Fewer significant correlations were obtained for electrical capacitance. Since previous work has determined a relationship between p and the electrical characteristics (Byrne and Troy, 1996) and a relationship has also been found between pH and meat quality (O'Halloran *et a* 1995), a stronger relationship between the electrical characteristics and meat quality was expected. The lack of strong correlations betwee electrical characteristics and meat quality parameters achieved in this study is thought to be due to the low range in meat quality achieved in thi study. It is thought that further work incorporating a wider range in meat quality may achieve stronger relationships with the electrica characteristics.

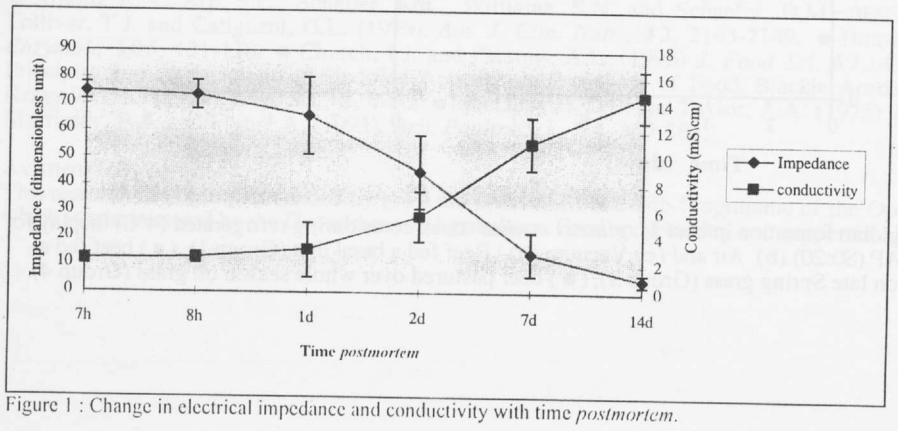

Figure 1 : Change in electrical impedance and conductivity with time *postmortem*.

Table 1: Simple correlation coefficients between electrical impedance and selected quality attributes in beef loin.

	I_{48h}	I_{7d}	I_{14d}
Juiciness48h	NS	0.46	NS
Driploss	-0.45	-0.46	NS
Cookloss7d	NS	0.44	0.46

Table 2 : Simple correlation coefficients between electrical conductivity and selected quality attributes in beef loin.

	C_{48h}	C_{7d}	C_{14d}
Juiciness48h	NS	-0.43	NS
Driploss	NS	NS	NS
Cookloss7d	NS	NS	-0.40

Most of the previously published work carried out on the electrical properties of meat has concentrated on the prediction of PSE and DFD meat. Many workers have produced results to suggest that electrical measurements are capable of predicting PSE (Garrido *et al.*, 1995; Oliver *et al.*, 1991; Brown, 1992) and DFD meat (Swatland *et al.*, 1982). Others produced less favorable results (Warriss *et al.*, 1989). Some workers have suggested that electrical impedance (Pliquett *et al.*, 1990; Pliquett *et al.*, 1995) or electrical conductivity measured at a specified time *postmortem* can characterise the quality of meat quickly and reliably (Garrido and Honikel, 1995). These workers, however, have related electrical characteristics to quality attributes such as drip loss, colour brightness and pH and few publications exist which relate the electrical characteristics to meat tenderness or texture. Garrido and Honikel (1995) obtained high correlations between electrical conductivity at 24 hours and Minolta L*, a* and b* colour values at 24 hours *postmortem* (r=0.82, 0.11 and 0.48 respectively) compared with those obtained in this study for 48 hour Hunter Lab colour values (r=-0.06, 0.06 and -0.05 respectively). Therefore, with further work this relationship may improve.

Conclusion

Few significant correlations existed between meat quality and the electrical properties measured. However, electrical impedance and conductivity did show some significant correlations with the quality parameters showing promise for these measurements as on-line quality indicators. Electrical capacitance was not well correlated with meat quality. Further work examining a greater variation of quality in meat is now under way in an attempt to achieve stronger relationships.

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