Bioimpedance measurements as a tool for evaluating emerging meat defects in pork ham

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Introduction: Pork quality defects are typically assessed by drip loss, pH and color measurements. Yet, tissue and meat disintegration, e.g., separated fibers and muscle bundles, are likely the most severe defects that producers and consumers do encounter, in particular with cured ham products. In contrast to discoloration, such as pale meat, no standard method is established yet to measure muscle cell and connective tissue damage.

To address this, we tested raw ham cuts with bioimpedance (BI) measurements, an established method for medical and food quality applications. More specifically, the bioimpedance response in meat is determined by a tissue's capacitive and resistor-like elements and reflects the integrity of cell membranes and extracellular exudate build up.

For chicken and pork meat, we have previously demonstrated the sensitivity of BI measurements for gross texture damage, induced by subjecting meat to freezing (e.g., Egelandsdal et al., 2019). In addition, we found that BI changes reflect typical tissue degradation during postmortem (pm) chill storage. Here we ask, if meat quality defects that are currently reported by meat producers, and that resemble certain features of previous PSE linked defects, can be detected by BI measurements. As there is no gold standard established yet for new emerging meat defects, we here ask how BI correlates with common meat quality parameters, that are used for detecting pork defects, i.e., pH, color and drip loss.

Material and methods: We tested 84 pork ham cuts (M. semimembranosus) that were randomly selected at the cutting line. Quality evaluation and tissue sample collection were done 3 days pm. Meat quality tests were done at two defined locations in the muscle, one central and one peripheral. The BI response was tested using a tetrapolar electrode setup and a Zürich Instruments MFIA impedance analyzer (Switzerland; frequency range [10 Hz; 1 MHz]). In addition, we measured pHu, CIE Lab color coordinates using a Minolta Chroma Meter CR-400 (Japan) and drip loss for a period of 3 days using the EZ-DripLoss system (DMRI, Denmark).

Results: For the tested samples we confirmed a marked quality heterogeneity, based on color (L*a*b*), pHu and EZ-DripLoss values. We also observed signs of fiber bundle separation, indicating that structural integrity was compromised in a number of samples. We report that BI responses (assessed as Py-parameter; Pliquett et al., 2003) differed for the two different ham locations, as did other quality parameters ($P_{peripheral\ vs\ central} < 0.05$ for Py, pHu, L*, a*and b*, but $P_{peripheral\ vs\ central} = 0.055$ was for EZ-DripLoss, paired T-test). Finally, we report that Py correlated with other quality measures, with stronger correlations in particular with b*, a* and drip loss at the peripheral location.

Conclusions: While previous findings suggest BI measurements being sensitive to storage related meat disintegration, we here show that BI can be a suitable addition for quality monitoring of emerging ham defects As BI is particular sensitive to microstructural tissue degradation, we propose that this method can be suitable for quality testing with a focus on cellular damage and changed meat juice distribution in ham.

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