MYOPATHY SCORE FOR PSE-LIKE SYNDROME IN A NORWEGIAN PIG POPULATION

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I. INTRODUCTION

Pale, soft, and exudative (PSE) like quality defects in pork are a significant financial burden on the meat industry, especially in the production of premium products such as ham [1]. PSE-like pork, also called destructured meat, is characterised by, e.g., pale color, reduced water binding capacity and structural deterioration of muscle fibers [2]. Despite ongoing research, there is a lack of understanding about possible relationships between defects and histopathological findings. To address this issue, we here investigate the prevalence of typical myopathy pathologies in a Norwegian pig population that is also assessed for PSE-like defects. To this end, we firstly established a new catalogue of myopathy features present in our study population and based on previous muscle pathology studies. We hypothesised that expression of histopathological sets of pathologies may be linked to visible, macroscopic PSE-like defects. Our work may help improving our understanding of possible interactions between typical pathological and meat quality traits through providing histological assessment guidelines.

II. MATERIALS AND METHODS

For defect assessment of the PSE-like syndrome we adopted a ranking system that is based on evaluating destructured meat zones and color (established by IFIP [3]). Defect ranking is detailed in Figure 1, A-D. For histopathology, 99, 1 x 1 x 1 cm skeletal muscle samples were collected 24 h post-mortem following PSE-like syndrome grading. All samples were excised from the same site of the inner, central part of muscle semimembranosus (SM). The tissue samples were fixed in 4% neutral-buffered formalin, paraffin embedded, and serially sectioned at 4 µm thickness. Muscle samples were oriented transversally and longitudinally in relation to fibre direction and stained with hematoxylin and eosin (HE). Samples then were scanned with the Philips IntelliSite Pathology Solution (PIPS, The Netherlands, 2020) and whole slide digitalized images were obtained. Myodegeneration, as reported by [4], is characterised by hypercontraction, loss of cross striation and/or fiber fragmentation, sometimes associated by inflammatory response. For histopathology evaluation, we here assessed a set of myopathy features, which was blindly graded and quantified (for details see Fig. 1). The association between the histological grades and PSE-like defect ranks was assessed with Fisher's exact test. Significance levels were $P=0.05$, $P<0.001$ for all tests. Statistical analyses were performed using Minitab version 19 (LLC, Pennsylvania).

III. RESULTS AND DISCUSSION

To this end, a grading system was established that allows visual, whole slide evaluation with ranks from 'without pathological findings' to most severe myodegeneration (Fig. 1, E-H). We found that myodegeneration was significantly associated with destructured meat scores (DES) ($P<0.001$). More than 67% of the DES0 hams were also found to rank as MYO0. In contrast, more than 72% of hams with a varying degree of PSE-like defects (DES1-3) were represented by MYO1-3. Most of PSE-like hams exhibited lower myopathy ranks (MYO0 or MYO1). However, more than 39% of the most destructured PSE-like cases (DES3) were also ranked as most severe myodegeneration (MYO3).

Pork meat quality defects, such as PSE-like defects, have been previously characterised using histopathology techniques. However, there have been limited attempts to quantify these defects,

particularly in the context of "destructured meat." Our study supports the findings of [5], who describe PSE zones as regions with disorganized muscle fiber alignment and the presence of hypercontracted fibers with fractures.

We believe that semi-quantitative microscopic evaluation together with macroscopic assessment can be a valuable tool for studying meat defects, such as destructured meat.

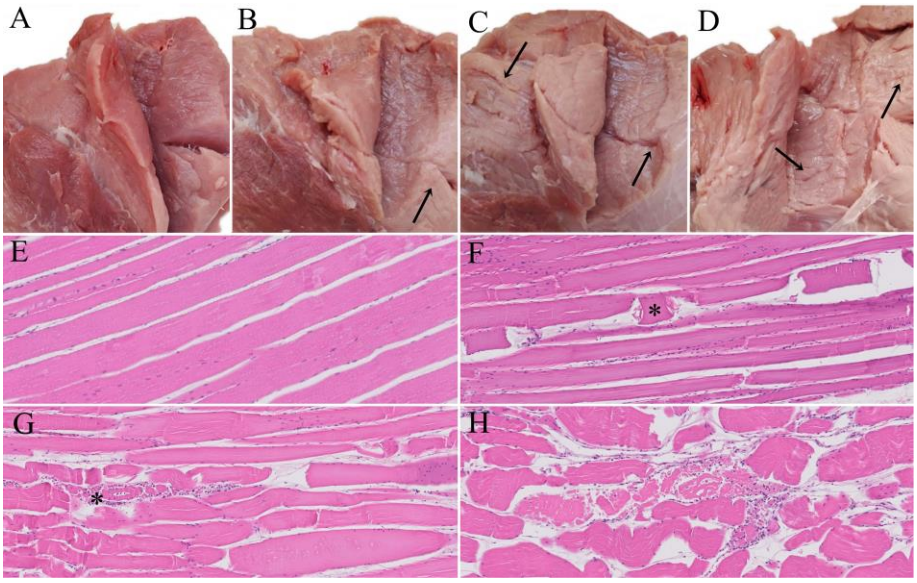

Figure 1. (A-D) Destructured defect grading in skeletal muscle, muscle semimembranosus, swine. (A) DES0, normal looking color and lack of visible defects. (B) DES1, small pale areas on the surface with single pale patches of destructured zones (arrow). (C) DES2, large pale areas of destructured zones, both on the surface and inside (arrows). (D) DES3, large pale areas of destructured “cooked “zones with visible fiber disintegration, both on the surface and deep inside the muscle (arrows). (E-H) Myodegeneration grading, hematoxilin and eosin staining. (E) MYO0, unaffected muscle with no signs of degeneration, (F) MYO1, single segmentally myodegenerated fibers, (asterisk) (G) MYO2, multiple degenerated fibers often associated by cellular infiltration (asteriks), (H) MYO3, widespread segmentally degenerated fibers often accompanied with macrophages and cell debris.

IV. CONCLUSION

In all, our data suggest that the implementation of whole-slide, semi-quantified histopathological guidelines together with macroscopic evaluation can offer a new perspective for understanding possible causations that may be shared by myopathies and meat defects in pork.

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