71st ICoMST
GIRONA - CATALONIA - SPAIN
3rd-8th August - 2025

MAPPING MYOPATHIES IN PIGS – IMPLICATIONS FOR PORK QUALITY?

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I. INTRODUCTION

Global pork production faces increasing demand, driving the need for affordable, high-quality meat. While advancements like growth performance have improved, the presence of myopathies raises problems [1]. Unlike chicken myopathies, pork myopathies are not well studied and there have been limited attempts to characterize these anomalies [2]. Features of pork myopathies have been linked to a global challenge – PSE-like defects in deep ham muscles [3]. However, the impact of and specific mechanisms that may link skeletal muscle degenerations and meat quality are still unclear. To address this issue, we here assessed myopathy prevalence in a Norwegian pig population. A novel whole slide image analysis and semiautomated quantification method was used to characterize specific muscle degeneration markers. We hypothesize that integration of these methods could improve identification and diagnostics of pork myopathies and contribute to a better understanding of possible interactions between pathology and meat quality traits.

II. MATERIALS AND METHODS

For histopathology 99 pork skeletal muscle samples (1 x 1 x 1 cm^3) were collected about 24 h post-mortem on five different days from a single abattoir that receives pigs from different producers. All samples were excised from the same site of the inner, deep central part of semimembranosus (SM) i.e., typical muscle for PSE-like quality defects development. All samples were fixed in 4% neutral-buffered formalin, paraffin embedded and serially sectioned at 4 µm thickness. The samples were oriented transversally and longitudinally in relation to main fibre direction and stained with HE, PTAH and Masson's Trichrome ([4] for general histopathology). Scanning was performed with the Philips IntelliSite Pathology Solution (PIPS, The Netherlands, 2020) to obtain whole slide digitalized images. Different features of myodegeneration, included hypercontraction, loss of striation and/or fiber fragmentation, sometimes associated with inflammatory response. A set of myopathy features was assessed by blindly grading using a 4 grade system (MYO0–3). Histograms and descriptive statistics were generated with Minitab 19 (LLC, Pennsylvania).

III. RESULTS AND DISCUSSION

For the studied pig population myodegeneration was detected for 60% of all individuals. Histological grading revealed clear variability in myopathy severity across the sampled population, ranging from unaffected to severe lesions, with almost 20% showing widespread presence of muscle pathology features (Fig 1). More specifically, microscopic analysis revealed clear signs of muscle degeneration, including hypercontracted and swollen fibers, segmental loss of striation, and vacuolation. Inflammatory infiltration was also evident, with phagocytosis of degenerated myofibrils observed in several samples (Fig. 2). These features can be associated with rapid post mortem processes or sub-acute myodegeneration processes. This may suggest that not all myodegeneration has emerged post mortem [4]. To better clarify the onset of the different lesions, analyses are underway to compare fresh muscle biopsies, collected around slaughtertime and to investigate possible interaction with pre mortem processes and factors like e.g., slaughter weight and carcass temperature.

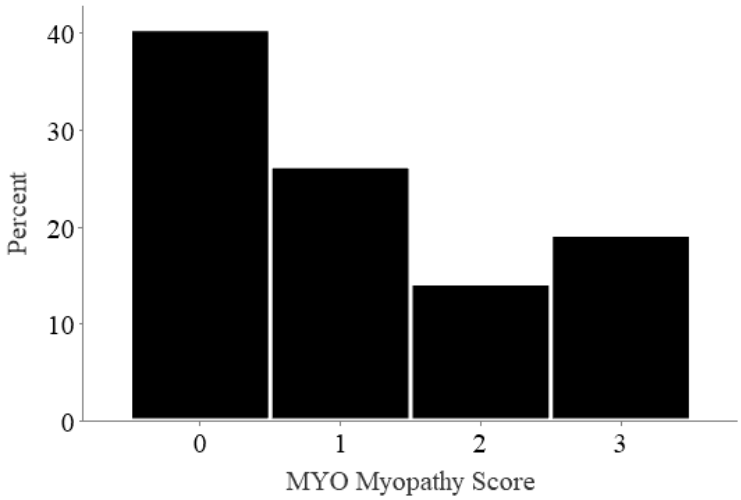


Fig. 1. Histogram of microscopically assessed myopathy grades for the analyzed sample population (n = 99). Myopathy grading revealed marked quality heterogeneity within the sample population, with 40% of hams scoring as MYO0, 26% as MYO1 (mild), 14% as MYO2 (moderate), and 19% as MYO3 (severe) [4].

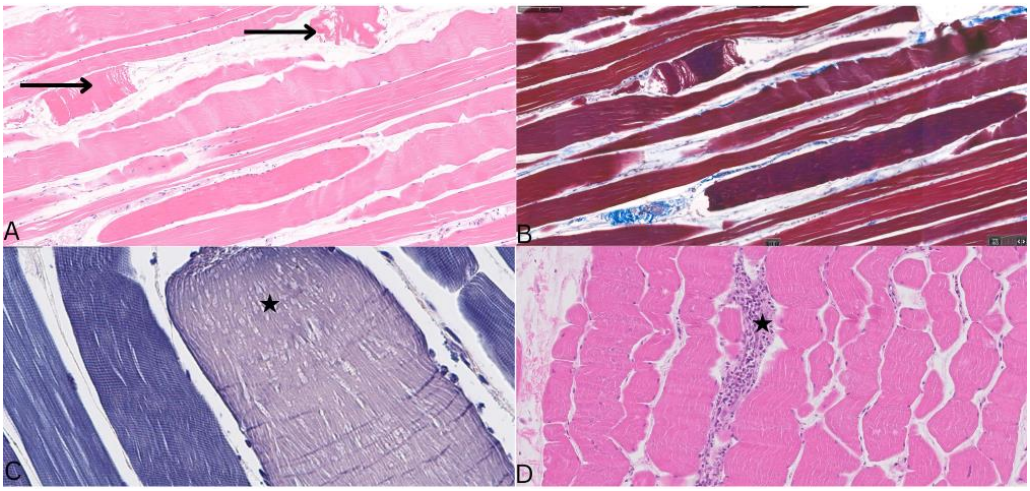


Fig. 2. Skeletal muscle samples with myopathic features (longitudinal sections of the semimembranosus muscle; HE, Masson's Trichrome, and PTAH stainings). A-C. Degenerated fiber (DF): hypercontracted, swollen fibers lacking cross striation and segmental degeneration (arrows) and severe vacuolation (star) D. Infiltration of inflammatory cells phagocytizing degenerated myofibrils.

IV. CONCLUSION

- The high prevalence of myopathy in pigs highlights a need for deeper understanding of their functional consequences and link to meat quality e.g., like PSE-like defects in deep ham muscles.
- Future studies will focus on comparing early post mortem and cooled meat samples to define if acute features are solely a post mortem effect due to e.g., high temperature and slaughter weight.
- These results emphasize the importance of routine histopathological screening, as many cases may remain undetected without microscopic evaluation. To this end, classical muscle pathology remains a valuable diagnostic tool with possible applications in both meat quality assessment and animal health monitoring.

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