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Text-mining assessment of hot boning applications in meat research and associated processing technologies: Analysis of current knowledge and research trends

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I. INTRODUCTION

Hot boning (HB) in meat processing is characterized by the removal of meat from the carcass shortly after slaughter (often within 90 minutes post-slaughter) [1]. One of the most significant advantages in HB is the potential reduction in energy expenditure. Since hot boning involves optimised cooling of edible meat only and not excess bone and fat, it has been estimated that hot boning could require 40-50% less chilling input, reduce chiller space by 50-55% and reduce labour by as much as 25% [2]. With the aim of exploring the different approaches and research trends related to HB in the literature, this paper investigates the multifaceted landscape of HB within meat quality research and processing, employing a text-mining approach. An analysis of the interconnected terms aims to offer a comprehensive look into the current research and processing trends related to HB in beef processing.

II. MATERIALS AND METHODS

A literature search was performed in the Scopus database up to April 2024, using the keywords “hot-boning” OR “hot boning” AND “meat” OR “quality” OR “trait” AND “beef” OR “bovine” or “cattle”. The search yielded 55 papers based on the titles, abstracts and keywords search. One paper dealing with horse meat was disregarded. The search data were then processed with VOSviewer software to identify the research trends and main clusters that characterize the keywords used. The analysis was further combined with in house review on HB on beef.

III. RESULTS AND DISCUSSION

The visualization clusters primarily highlight three thematic areas (Figure 1): meat quality and muscle biochemistry (red), safety (blue) and physicochemical properties of the meat (green). Central to these clusters is the concept of 'hot boning', which appears as a pivotal practice within the red cluster that closely links to 'meat,' 'tenderness,' and 'sarcomere length.' The red cluster suggests that a significant focus of hot boning research relates to its impact on meat quality, particularly tenderness - a critical attribute for consumer satisfaction. The data reflects that HB can influence meat tenderness by interacting with and influencing muscle physiology. For instance, when the temperature of muscles is low pre-rigor, extensive shortening of sarcomeres has been observed, and, as a consequence, the toughness increases in the process denoted cold shortening, as indicated by the terms 'sarcomere length' and 'tenderness' in close proximity. For cold shortening to occur, certain conditions must be met: the pH of the muscle has to be greater than 6.0, ATP should still be available and muscle temperature to be less than 10℃ [3]. To avoid such situations, different technologies can be applied such as electrical stimulation, slow chilling and hanging.

In the blue cluster, the terms *'Escherichia coli*,' 'food contamination,' and 'food microbiology' are prominent, revealing a strong linkage to meat safety concerns. In fact, HB could impact microbial growth due to the higher temperatures at which meat is processed. The proximity of these terms suggests that current research is investigating whether HB can either reduce or worsen the risk of microbial contamination. Considering the paramount importance of food safety within meat processing, understanding these dynamics is crucial for regulatory compliance and public health assurance.

The green cluster focuses on 'pH,' 'low temperature,' and 'hydrogen-ion concentration,' emphasizing the importance of physico-chemical dimensions during processing of meat and the final outcome in relation to meat quality. The manipulation of these properties during the HB process can affect the endogenous proteolytic systems through the rate and extent of pH decline, which are critical for several intrinsic quality traits. This signifies ongoing investigations into how HB influences these parameters that are crucial both quality and safety of beef.

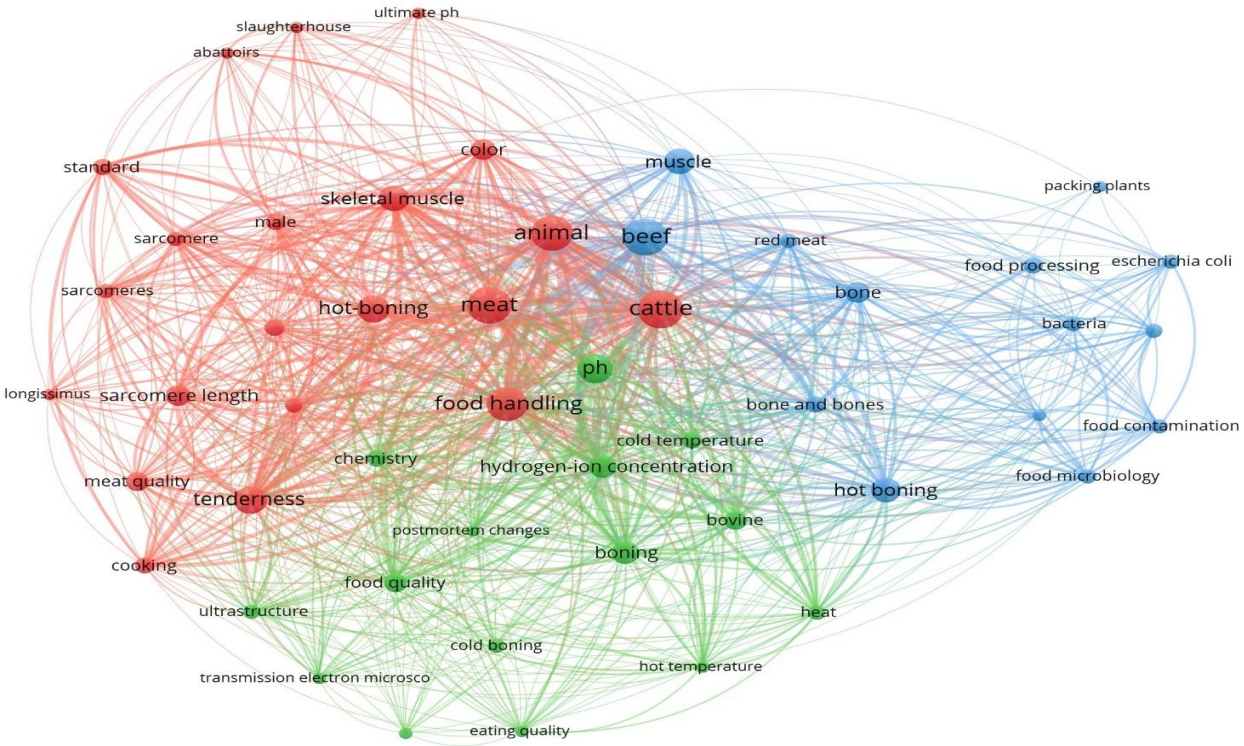

Figure 1. Network of most frequent terms based on their co-occurrence in the selected articles

IV. CONCLUSION

This study explored the applications of HB in meat research and processing. It offers a textualized understanding of how HB is situated \within the wider topics developed in meat science. While HB is linked to potential improvements in processing efficiency and meat quality, it also requires careful management of food safety. Future research should continue to explore these relationships, particularly through studies that assess the long-term impacts of HB on sustainability in the beef industry. Furthermore, the integration of consumer perception studies could synchronize processing innovations with market demands. This text-mining assessment not only underscores the multifaceted impacts of HB on the beef industry, but also directs attention towards integrated research methodologies that maximise quality, safety and sustainability - key factors for advancing a more resilient and consumer-responsive beef sector.

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