



## PROJECT SUMMARY PRODUCT QUALITY

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# Post-Harvest Handling Challenges to Optimize Beef Quality: What Do We Know and Where are the Knowledge Gaps? – A Comprehensive Review and Evaluation of the Scientific Literature

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# Post-Harvest Handling Challenges to Optimize Beef Quality: What Do We Know and Where are the Knowledge Gaps? – A Comprehensive Review and Evaluation of the Scientific Literature: Project Summary

## Background

Palatability of beef, especially tenderness, is one of the most important criteria affecting consumer satisfaction of beef. Consumer acceptance of beef depends on a positive eating experience that includes their perception of tenderness and flavor (Guelker et al., 2103). With time, there has been dramatic improvements in the efficiency of beef production. For example, the current U.S. beef cowherd is one of the smallest since the 1960's; however, kilograms of beef production in the U.S. remains relatively unchanged since 1966 (NASS, 2017). These improvements are driven by genetic selection, nutritional strategies, and growth promoting technologies, all of which are necessary to support the increased global demand for protein expected with a human population estimated to exceed 9 billion by 2050 (Alexandratos and Bruinsma, 2012). In addition, there has been dramatic advancements in scientific knowledge regarding applications to alter post-mortem changes and improve beef palatability – but much of this information is located in individual, original research publications.

## Objectives

The objective of this work was to address the need to critically review the state of the art knowledge regarding how important post-harvest handling factors impact the palatability of beef. This review will assist the industry in making informed decisions regarding changes that could be made immediately. In addition, this review will be an important tool in assessing where the critical gaps in the knowledge are and potentially what could be done to address those gaps.

## Methodology

An extensive literature search and review was conducted on published scientific research articles that address post-harvest and some pre-harvest factors that impact beef palatability. The review of literature included factors such as temperature decline of early post-mortem muscle from harvest to final chilling, chilling temperature and time, and the use of electrical stimulation, high pressure processing, and aging duration (considering both short- and long-term aging), to list a few. The literature was evaluated with respect to applicability of the works reviewed to the modern and future beef industry. The final document is a white paper that is currently undergoing the final stages of editing.

## Important Findings

Meat is a very complex tissue, especially in the first few hours after exsanguination. In those first hours, meat is still actively metabolizing and many of the processes currently utilized have the potential to alter the metabolism, in some cases profoundly. Thus, also the final quality of the product. Another key finding from this research is the impact that certain ante-mortem factors have on final product quality. Not just because of the impact they have on the final composition, but also because of the impact that they have on important metabolic processes. There is a synergy between live animal husbandry and post-mortem carcass handling that must be recognized to optimize the potential to produce the highest quality product. These combinations of factors are largely overlooked in large scale beef production industries. The potential for new ways to improve beef quality are greatest in systems approaches. For example, some of the newer technologies such as high pressure and ultrasound have promise to be used effectively on pre-rigor products in smaller scale, high-quality operations to improve palatability more uniformly. There are also several newer studies that show how careful use of timing and temperature may optimize novel technologies like high pressure, ultrasound and pulsed electric field (**Table 1**). This review has exposed the need to further investigate optimal times and methods to apply these new technologies to enable the beef industry to make the best use of them. Further exploitation of these technologies will be advanced more quickly if deeper studies on the biochemistry of the early post-mortem muscle is more clearly understood so that we can more accurately predict when to use these technologies.

## Industry Impact

This review provides insight into novel technologies currently available to improve beef tenderness and describes some of their limitations, as well as identifies new areas that need to be addressed by the beef industry to improve the consistency of beef eating quality. A significant emerging need is to understand the impact of carcass size, as increased carcass size may be an impediment to cooling which is known to influence eating quality traits. In addition, more

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research is needed to understand if new technologies could be layered to improve beef tenderness. The recent discoveries in biochemistry and the complex interactions that occur when meat converts to muscle will help the beef industry understand how new technologies could be developed or existing techniques could be modified to optimize meat tenderization.

## Tables

Table 1 - Selected Newer Technologies Reviewed in the Manuscript – New Studies

Technology	Effect on Tenderness	Selected Important New References
High Pressure Processing	Improved shear force in post-rigor beef when applied to pre-rigor beef	Morton et al., 2018. Meat Science. 143:129-136. Morton et al., 2017. Meat Science 133:69-74
	Improved tenderness and color of zebu beef	Neto et al., 2015. Food and Bioprocess Technology. 8:837-843.
	Application at 15°C improved tenderness of beef <i>semitendinosus</i> (eye of round)	Kim et al., 2007. Food science and Biotechnology. 16:49-64.
Ultrasound	Decreased shear force of semitendinosus	Wang et al., 2018. Food Chemistry. 245:724-730.
	Decreased shear force of <i>longissimus</i> by accelerating proteolysis	Kang et al. 2017. Ultrasonics Sonochemistry. 38:317-325.
Pulsed Electric Field	Reduced shear force of pre-rigor <i>biceps femoris</i> – limited effect on pre-rigor <i>longissimus dorsi</i>	Suwandy et al., 2015. Meat Science 105:25-31.
	Reduced shear force of post-rigor <i>longissimus dorsi</i> – limited effect on post-rigor <i>semimembranosus</i>	Suwandy et al., 2015. Food and Bioprocess Technology. 8:1218-1228.
	Repeated treatments had a significant effect on hot boned beef <i>Longissimus dorsi</i> and <i>semitendinosus</i>	Behkit et al., 2016. Meat Science. 139-146
	Differential effect on post-rigor muscles differing in fiber type	Behkit et al., 2014. Food and Bioprocess Technology. 7:3136-3146.

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