

Chapter 1

Introduction

A consumer judges meat quality through appearance, texture and flavor. The surface color and appearance strongly influence a consumer's initial selection of fresh and processed meat products. Consumer satisfaction with tenderness of that product will further determine if the purchase is repeated in the future such that decreased tenderness reduces consumer satisfaction (Morgan et al., 1991). It is critical for food scientists and meat processors to consistently produce a tender meat product that meets or exceeds consumer expectations.

Post-mortem technologies that enhance the tenderness of meat products are economically important to both the processor and producer. As consumer satisfaction increases, sales are likely to increase. A variety of techniques have been developed and introduced to tenderize poultry. Many technologies including electrical stimulation (Froning and Uijttenboogaart, 1988; Maki and Froning, 1987; Lyon et al., 1989; Dickens and Lyon, 1993), muscle restraints or stretching (Pearson, 1987; Lyon et al., 1992), marination (Young and Lyon, 1997), and a combination of these methods (Sams et al., 1991) have provided positive results for improving meat tenderness. Although these methods have produced desirable results for the poultry industry many of these technologies lack effectiveness for poultry. Therefore, the poultry industry commonly utilizes a delayed boning phase to assure an acceptably tender product. This delayed boning method utilized by poultry processors is different from the aging process used on beef and lamb carcasses. The mechanism of beef aging also involves extensive enzymatic proteolysis of muscle proteins including connectin, gap filaments, and other

myofibrillar proteins (Pearson, 1987) that occurs during pre-rigor and post-rigor phases. Beef primal and subprimal cuts are vacuum packaged and aged for days. Extended aging produces a tender beef product with a distinct flavor and is used primarily for the hotel and restaurant trade. In contrast to beef muscles that are left intact on the carcass for 20 to 24 hours, the broiler breast remains intact on the carcass under chilled conditions for only 4 to 7 hours. This process allows the chicken breasts to complete rigor while the muscles are still attached and restrained by the bones. Without this restraint, the muscles shorten during the conversion from muscle to meat and result in tough chicken breasts. This post-mortem aging process is time consuming and costly due to required cooler space, equipment, purge losses, and labor costs.

The Hydrodyne process redesigned by John B. Long (U.S. patent #5,273,766 and #5,328,403) is a novel technology being developed and tested by the USDA's Agricultural Research Service Meat Science Research Laboratory to tenderize beef, pork and lamb. The process utilizes an explosive to create a shock wave in an enclosed, specially designed tank filled with water. In a fraction of a millisecond, the shock wave passes through the water and objects that are a mechanical impedance match to the water (Kolsky, 1980). The meat's cellular components are instantaneously ruptured, thereby improving meat tenderness. At the front of the shock wave, compression occurs as the wave passes through the muscle tissue. Once the wave has passed through the tissue and is reflected off the steel tank, tension occurs (Solomon et al., 1997). It is the pressure front generated by these two forces which creates the tenderizing effect (Solomon et al., 1997). This process has shown a 66% increase in tenderness of hot-boned beef *Longissimus* muscle stored 24 hours prior to treatment with 100 g of explosive. Solomon

et al. (1997) reported that tenderness of fresh beef strip loins was improved 49 to 72% using the Hydrodyne process depending on the magnitude of explosive. The largest tenderness improvement was determined in the samples exposed to two sequential Hydrodyne treatments (Solomon et al., 1997).

The red meat industry is actively pursuing the Hydrodyne technology with the prospect of eliminating the costly aging step and improving tenderness, particularly in less tender meats. If such savings and improvements are realized with the Hydrodyne process, increased price competitiveness and consistency in tenderness will likely necessitate similar advances in poultry in order to maintain its market share. Currently, there is no known published literature utilizing the Hydrodyne technology for tenderizing early de-boned broiler breasts.

Ideally, the introduction of a new method to process broiler breasts should be cost effective, fast, and not negatively interfere with the breast meat quality. The Hydrodyne process was investigated to determine if the poultry processing aging step could be eliminated for broiler breasts with the incorporation of the Hydrodyne technology. Determination of the Hydrodyne process efficacy in this study was determined by analyzing quality characteristics of Hydrodyne treated early de-boned broiler breasts.

The remaining chapters of this thesis include: a literature review, a research chapter, and conclusions. Chapter 3 is presented in journal article format to facilitate submission to Poultry Science for publication. The objectives of this research were:

1. Determination of the optimal combination of explosive level and distance of explosive to the meat surface for tenderizing early de-boned broiler breasts using the Hydrodyne process, based on instrumental shear force measurements.

2. Evaluation of meat quality characteristics including tenderness, cooking and purge losses, breast thickness, color and sensory characteristics of early de-boned broiler breasts treated with the most effective explosive amount and distance combination observed in objective 1 using the Hydrodyne process.

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