

# Red Meat Science and Production

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Volume 1. The Consumer and Extrinsic  
Meat Character

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# Preface

*Red Meat Science and Production* is a comprehensive compilation of research performed to reveal the science of red meat in order to understand the fundamentals undergirding its production. Red meat not only is the product of a lifetime, the muscles of ruminant animals, but also is characterized by processes that take place after the animal dies when muscle becomes meat. The science of red meat, therefore, concerns the analysis of these complex biological processes.

The production of red meat involves the synthesis of these processes into holistic production systems orchestrating them toward red meats desired by consumers. Thus, *Red Meat Science and Production* begins with the consumer who determines the product character desired. The product character is described according to definable attributes. The biological and necrological sciences underlying the formation of these attributes are analyzed in order to synthesize them into production systems designed to consistently produce red meat products desired by discerning targeted markets.

Unlike many texts, *Red Meat Science and Production* is a thorough, comprehensive review of the literature of the science and practice of red meat production on a global scale, thereby reviewing about 4000 original and review technical publications. Because of the scope and scale of the text, the authors chose to limit commentary and let the research “speak for itself.” Therefore, nearly every sentence in the text is referenced in the scientific literature.

Many of the conclusions drawn are not the ideas of the authors but the conclusions drawn by scientists based on research evidence. The authors are careful to give credit to the originating scientists for every conclusion drawn in the text. The conclusions, evidence, and scientific publication citations are given so that the readers can make their own conclusions and draw hypotheses for further exploration of the science and production of red meat.

The authors are deeply indebted to colleagues who have performed the research reported herein. The authors are in awe of the volume and quality of research performed worldwide during the most recent decades linking the ruminant production

system to the character of red meat. The authors are also indebted to Mr. Clayton Ferdinand, chief executive officer of *Enhanced Exchange*, for his inspiration and motivation that provided the initiative for this work. This comprehensive work could not have been completed without the editing skills and diligence of Cindy Davis and Karen Dean.

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# Introduction

Meat quality is a multifaceted characteristic defined by the expectations and perceptions of consumers (Hocquette et al. 2012a). The primary reason for ruminant production is to produce products providing consumers with desirable eating experiences. Therefore, this text begins with consumer expectations and perceptions that define markets. The eating experience desired by the different consumers varies, but each consumer requires the meat to provide an array of the characteristics that have been classified as either intrinsic or extrinsic. Intrinsic traits are the characteristics inherent in the product itself that can be sensed at the time of consumption, and extrinsic traits are the characteristics associated with the product not verifiable during the eating experience (Hocquette et al. 2012a).

The extrinsic traits are price, any brand or quality label, and factors associated with production which are tangential to the product, especially those associated with humane treatment of animals, environmental friendliness of production, and the safety and healthfulness impacts the consumer may experience after consumption. Since different markets have different value systems, the relative importance of these traits is not the same worldwide. So, quality must be defined for each market. There is a general trend toward increasing the importance of contribution of the meat product to healthiness, safety, and other extrinsic quality traits (Hocquette et al. 2012a).

This text is tailored toward the identification, development, integration, and aggregation of production methods required to produce products deemed to have quality for the gamut of important global consumer niches. Such methods can be inferred, for example, from genomic results or data related to muscle biochemistry and physiology bringing to bear sciences to more precisely and accurately predict sensory meat character.

Australians have attempted to accomplish this global assurance quality scheme through their “Meat Standards Australia System” (Thompson 2002; Hocquette et al. 2012a). Their system of Total Quality Management involves system intrusions at critical control points. These intrusions include the selection of breed, growth path modification, and limitations in the use of hormonal growth promotants, controlling the temperature-pH window postmortem, tenderstretch technologies, and

postmortem aging (Thompson 2002). Although American meat production is less formalized, the production system, through iterations associated with the free market system, has been more successful than any other system in the world in producing consistently safe and quality meat (Tatum et al. 2012).

Much research has been accomplished in the last several decades designed to delineate production system elements and the underlying biology required to produce consistent quality beef having the combination of intrinsic and extrinsic characteristics necessary for the array of market niches extant in the world. The intent of this text is to catalogue and analyze this expansive body of research with the goal of synthesizing dynamic production systems designed to meet market demands for both intrinsic and extrinsic characteristics demanded by this array of global market niches. This volume of the text focuses on the extrinsic characteristics, while volume II focuses on the intrinsic characteristics with the goal of identifying indices conducive to consistent quality eating experiences.

The combination of indices inherent to safety and healthfulness, sensory and nutritional quality, social and environmental considerations (e.g., carbon footprint, animal welfare, biodiversity, ecological friendliness), and prosperity (the necessity for all in the production and supply chain to benefit from the success of the system as well as provide quality eating experiences at a reasonable consumer price) comprises the necessary red meat production/delivery system. This text analyzes the body of research and provides the basis for the synthesis of production systems targeted to produce distinctive red meat products for discerning markets across the world. Because of the relative importance of beef in the western world, much of the research reported in this text implicitly concerns beef. But, since all red meat is produced by ruminants (e.g., cattle, bison, buffalo, yak, sheep, and goats), inferences are drawn from the work on beef to other red meats.

This volume begins with considerations concerning the consumer (the market) and then proceeds to describe the biological processes and related production system elements associated with the extrinsic character of red meat, including the overriding characteristics of safety and price. The latter portion of the text addresses the extrinsic characteristics of red meat (such as those related to social and environmental considerations) that are increasingly becoming important in many markets around the world and will address production system elements that can be manipulated to ameliorate market concerns for these extrinsic characteristics.

In this text, each aspect of red meat quality is discussed separately especially as to the impact production system elements have on each component. At the same time, it is understood that each production system element occurs in the context of other elements and that each element impacts more than one facet of red meat quality. Therefore, as each attribute is discussed, there is some redundancy in discussing relationships with other facets. The ultimate goal of the text is to identify production system elements sensitive to all important aspects of red meat quality and to identify means to orchestrate these elements into cohesive production and delivery systems that consistently produce red meat products desired by a wide array of markets.

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