Meat Science and Muscle Biology Symposium: Pre-Slaughter Stress, Postmortem Glycolysis, and Biophysical Mechanisms of Meat Quality

655 Preslaughter stress and pork meat quality. L. Faucitano,* *Agriculture & Agri-Food Canada, Sherbrooke, Canada.*

At all times before slaughter pigs may experience stress from a range of handling practices, such as feed withdrawal, loading and transport, mixing, human interventions and slaughter. Frequently used welfare indicators for preslaughter treatment are behavioral and physiological (heart rate, hormones, and body temperature) responses. However, preslaughter stress is not only an animal welfare issue but also a meat quality issue as it may have short- and long-term effects on ante-mortem muscle metabolism and thereby on meat quality. The 2 major preslaughter stress-induced meat quality defects are PSE (pale, soft, exudative) and DFD (dark, firm, dry) pork. Acute short-term stress, such as no or short rest time after transport, rough handling while moving pigs toward the stunning area and the stunning process itself, can stimulate sympathetic arousal and adrenaline release triggering a rapid glycogenolysis and excessive lactate and heat production. This muscle metabolic condition may result in the formation of PSE pork depending on the glycogen content at the time of slaughter. A major effect of long-term stress, such as too extended feed withdrawal, transport and lairage times, and mixing of unfamiliar groups of pigs, is the reduction of muscle glycogen levels at slaughter leading to an insufficient acidification of the meat (higher ultimate pH) and production of DFD pork. However, the relationship between behavioral and physiological variables and meat quality parameters is sometimes conflicting. This discrepancy might depend on the different reaction to physical and psychological stressors of muscles differing in muscle fiber contractile properties, being the glycolytic muscles more prone to develop PSE pork and the oxidative ones to develop DFD pork. The objective of this review is to overview research findings related to the effects of preslaughter practices on ante-mortem animal physiological response, including muscle metabolism, and to provide recommendations aiming at limiting the effect of preslaughter handling on pork quality variation.

Key Words: meat quality, pigs, stress

656 Muscle glycogen and postmortem glycolysis. E. Poulanne,* *Department of Food and Environmental Sciences, University of Helsinki, Helsinki, Finland.*

Glycogen is a branched polysaccharide with linear chains of 12 to 14 glucosyl groups linked by 1,4-bonds. Glycogen has a variable molecular weight from about 600 000 up to 10^7 with 55,000 glucosyl units and 4000 chains, of which 2100 chains are on the outermost tier. The structure is optimized to provide the maximum number of available branches in a minimum volume. The chains (B chains) have 2 branching points where further chains are linked by 1,6-bonds to form the next tier up to 12 tiers. On the outermost tier, the chains are unbranched (A chains). Glycogen phosphorylase is able to degrade glycogen at a very high speed thus providing the energy substrate, glucose-1-phosphate, in periods of intensive exercise and stress. Glycogen phosphorylase can cleave the glucosyl units down to the fourth unit from the 1,6-bond. Following this, the glycogen debranching enzyme is required first to remove 3 glucosyl units and move them to another A chain, and then to degrade the 1,6-bond resulting in one free glucose molecule, which allows the further action of glycogen prosphorylase. In glycolysis, glucose-1-phosphate is converted to glucose-6-phosphate and then broken down to pyruvate by 9 different enzymes, yielding 3 ATP per glucose-1-phosphate (2 ATP of glucose molecules coming from the action of the glycogen debranching enzyme). Pyruvate is used oxidatively in the citric acid cycle or non-oxidatively to regenerate NAD+, resulting in 2 lactate molecules and the binding of 2 protons per glucosyl unit. Simultaneously, there is a net production of 2 protons per glucosyl unit which originate from the glycolytic pathway from different intermediates, depending of the pH of the medium at a given time.

657 Biophysical approaches for improving our understanding of meat quality. A. Karlsson* and D. Brüggemann, *University of Copenhagen, Frederiksberg C, Denmark.*

The texture and water-holding of meat are of utmost importance for consumer acceptance. Meat consists of approx. 70% water and approx. 20% protein, the latter being crucial for holding the myo-water in place. Proteins are also the main constituents that make up the structure of meat and meat products. Even minor structural and chemical changes as well as degradation of the proteins post-mortem, are therefore very important for the major meat quality attributes, including water-holding, color and texture. The proteins also undergo structural changes on heating, resulting in protein denaturation, which includes among other processes protein unfolding, and protein-protein interactions leading to protein aggregations. Therefore the quality of meat products, which is mainly governed by the meat structure, also changes drastically after cooking. Due the complexity of muscle tissue and meat raw material, our knowledge in this field is far from complete, and therefore there is a need for research to understand basic and underlying mechanisms involved to explain the variation of the important meat quality attributes, thereby making it possible to control the meat quality. Biophysics, where physical methods are used to explain and study biological phenomenon, has the potential for being a new way for a meat science paradigm shift, thereby making it possible to increase our understanding of mechanisms involved in the development of meat quality attributes, and also to obtain a more detailed understanding of the complex matrix of raw and processed meat. In this presentation we will show some preliminary results of biophysical approaches for improving our understanding of meat quality attributes using techniques including fluorescence lifetime microscopy, second harmonic generation microscopy, differential scanning calorimetry and high field NMR.

Key Words: meat quality, biophysics