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

Glycogen is a branched polysaccharide with linear chains of 12 to 14 glucosyl units 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 phosphorylase. 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.

Key Words: meat quality, biophysics