A field assessment of the effect of pre-slaughter conditions and genetic-stress susceptibility on blood welfare indicators in pigs

MD Guàrdia*†, J Estany‡, J Álvarez-Rodríguez‡, X Manteca§, M Tor‡, MA Oliver†, M Gispert† and A Diestre#

† IRTA, Centre de Tecnologia dels Aliments, Finca Camps i Armet, 17121 Monells, Spain
‡ Departament de Producció Animal, Universitat de Lleida, Rovira Roure 191, 25198 Lleida, Spain
§ Unitat de Fisiologia Veterinària, Universitat Autònoma de Barcelona, 08193 Bellaterra, Barcelona, Spain
# Pig Improvement Company, Avd Argull 80, 08190 Sant Cugat del Vallés, Spain
* Contact for correspondence and requests for reprints: dolors.guardia@irta.es

Abstract

The effect of pre-slaughter handling conditions and the RYR1 gene on blood cortisol, lactate and creatine phosphokinase (CPK) levels at exsanguination were assessed using 2,923 surveyed pigs from 106 deliveries to five Spanish abattoirs across two seasons. The relationship between blood parameters, carcass skin damage and pork quality traits was also assessed. The season influenced blood cortisol, lactate and CPK values. Females always showed higher concentrations of cortisol, lactate, and CPK than males. Pigs carrying the recessive allele of the RYR1 gene exhibited increased lactate and CPK concentrations but not cortisol. The cortisol concentration decreased in lean pigs that were slaughtered in winter after short lairage periods. The lactate concentration decreased with loading time and increased in summer with lairage time and carcass lean content. The CPK concentration increased with lairage time, carcass weight, and carcass lean content, and with the duration of winter transports. Each truck delivery only explained approximately 10% of the variance in blood parameters. Lairage time is the most influential pre-slaughter handling practice on the assessed welfare indicators. In addition, different optimal lairage times might be appropriate depending on season. Blood cortisol, lactate, and CPK concentrations increased concomitantly with skin damage score. Blood parameters were weakly correlated and they also showed low association with pork quality traits.

Keywords: animal welfare, blood constituents, pre-slaughter, RYR1 gene, skin damage, swine

Introduction

During the pre-slaughter and processing period, animals are exposed to a variety of handling practices in a relatively short period of time, which may cause suffering (Warriss 1996) and represent a significant source of economic loss (Guise 1991; Warriss et al 1998a). It is well known that stress-inducing practices such as on-farm fasting time, mixing of unfamiliar pigs at loading, loading time and lairage time lead to increased bruising and carcass damage (Guàrdia et al 1996, 2009) and to decreased meat quality (Faucitano et al 1998; Warriss et al 1998a; Guàrdia et al 2004, 2005). Stress may be caused by combining physical discomfort such as food and water restriction, fatigue due to the movements of the truck, pain due to shocks or slaps, long and rough transports, inappropriate temperatures or air speed), with psychological discomfort such as fear-induced change to the familiar situation (Terlouw et al 2008).

It has been shown that blood cortisol is a reliable measure of psychological stress (Knowles & Warriss 2000) whilst the concentration of lactate and creatine phosphokinase (CPK) represent good indicators of muscular activity or tissue damage (Van der Meulen et al 1991; Mitchell et al 1992; Fàbrega et al 2002, 2004; Yu et al 2007). Increased pre-slaughter stress results in higher blood cortisol and lactate, although only the latter has been shown to be strongly correlated with pork quality attributes (Barton-Gade & Christensen 1998; Hambrecht et al 2004, 2005). In addition, blood lactate at exsanguination has been recently proposed as a quantitative tool to improve animal handling, increased concentrations being correlated with specific pre-slaughter negative behaviours (jamming, rearing and backing up) (Edwards et al 2010).

In pigs, the RYR1 genotype (halothane gene) has been proven to play an important role in the response of the animal to pre-slaughter conditions (Grandin & Deesing 1998; Fisher et al 2000), with the recessive allele (n) being associated with stress susceptibility (porcine stress syndrome). Many studies have shown a detrimental effect of the halothane gene on both mortality rates during the pre-slaughter period (Eikelenboom et al 1978; Barton-Gade &