

Porcus

The effect of transport duration on selected stress metabolites in pigs measured with Point of Care Devices



By

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New technique to measure Glucose, Lactate & Triglycerides: Rapid diagnostic test



Figure 1 Glucometer Elite, Accutrend GCT and Accutrend plus

Pigs incur stress during transportation from the farm to the abattoir. Stress before slaughtering of pigs causes poor meat quality, even among animals that are free from the malignant hyperthermia gene. A manifestation of stress can be seen in changes in behavior. While it is difficult to measure the changes in behavior during transportation, it is easier to relate the physiological changes to the stress levels using some serum metabolic substrates such as glucose, lactate, triglycerides and cortisol. The stress is caused by physical or psychological factors. The physical stressors include fighting, loading and off-loading while the psychological stressors include anxiety and fear.

Although many methods for assessing stress levels exist, they are invasive (*viz.* blood sampling), impractical (*viz.* collars for measuring heart rate) or time-consuming (*viz.* behavioural analysis). These methods usually require expensive equipment and rigorously trained personnel and the results of the tests will often take a number of days to come out which delays decision making. Given that abattoirs slaughter many pigs daily, there is a need for quick, reliable methods that allow good decisions to be made at relatively low cost. Simple, effective, non-invasive and/or minimally invasive ways of assessing the welfare of the pigs before slaughter are critical to identify the stressed pigs enabling specific interventions to mitigate the effects of the stress on the pork.

In medical circles, "point-of-care" diagnostic testing which refers to tests that can be performed at the patient's bedside or in a doctor's surgery, allowing physicians to diagnose patients more rapidly than traditional laboratory-based testing is well established. Using one of the main principles used in the point-of-care tests that involves the immuno-chromatographic or lateral flow devices (LFDs) exemplified in the home pregnancy test, a rapid diagnostic kit for the assessment of pig salivary cortisol levels using lateral flow technology was developed (Lane, Flint & Danks, 2002). Other rapid diagnostic tests already being used to routinely monitor blood glucose, lactate and triacylglycerols in the medical fraternity have however not been used to assess stress in pigs.

Since the plasma metabolic substrates are affected by stress and can be determined by minimally invasive ways, there is scope to employ them in the pig industry to improve the quality of the pork produced. Advantages of using the rapid diagnostic methods include the fact that personnel assessing the state of the pigs would need no scientific training and because no interpretation of the results is needed, bias and personal variation are eliminated (Lane, Flint & Danks, 2002). The main objective of the study was to measure the levels of metabolic substrates in pig saliva and plasma subjected to stressful conditions using rapid diagnostic tests and relate them to meat pH, drip loss and carcass temperature of the meat. It was envisaged that such a relationship if established would enable the identification of stressed pigs likely to produce poor quality pork and enable prophylactic measures to be taken before slaughter to come up with good quality pork.

Materials and methods

Animals, Housing and feeding

Forty Large White X Landrace (LW x LR) pigs (20 males and 20 females) weighing approximately 67 ± 6.5 kg and at the age of 5-6 months were randomly selected from the pig herd at ARC-API. The animals were housed in groups of twelve in 5 x 3 m fully slatted pens with concrete floors, in enclosed and temperature-controlled houses. The pigs were fed a commercial grower diet *ad libitum* to meet and exceed the recommended nutrient requirements for growing pigs (NRC, 1998) while water was freely available throughout the study. Just before slaughter, 10 male and 10 female pigs were subjected to a stressful transport regime consisting of transporting the pigs along the bumpy back roads around the ARC-API premises for 2 hours in a pickup truck. The remaining 10 male pigs and 10 female pigs were transported for 15 minutes from the pens directly to the abattoir in the same pickup truck. Saliva samples were collected from each pig the day before slaughter to get baseline measurements, on the day of slaughter before transportation to the abattoir and again after transportation just before slaughter. This was done by allowing individual pigs to chew cotton balls attached to pieces of string for 1-2 minutes until the buds were thoroughly moistened. The saliva was transferred to test tubes using syringes and then stored in separate vials at 20 °C analysis for cortisol determination. Plasma glucose, triglycerides and lactate concentrations were determined by pricking the ear vein of each pig and transferring drops of blood into test strips which were then inserted in POC devices (Accutrend[®] Plus, Roche Diagnostics GmbH, Germany; Glucometer Elite, Bayer) for immediate readings.

Slaughtering procedure, measurements

Pigs were slaughtered humanely and warm carcass weight was then measured using an overhead scale. After 45 minutes, pH and temperature readings were taken from the *Longissimus thoracis* muscle (LT) with a portable pH meter (EUTECH Instruments, Thermo Fisher Scientific). The carcasses were then placed in a cold room kept at an approximate temperature of 0 °C for 24 hours and then the cold carcass weight was measured by the same method as for warm carcass weight. The pH and temperature of the *Longissimus thoracis* muscle were measured again at 24 hours. Following carcass weight, temperature and pH measurements, the carcasses were split into two parts and back fat was measured between the 2nd and 3rd rib about 60mm from the mid line on the left side of the carcass using a pair of Vernier calipers. The pH of the *Longissimus*

thoracis muscle was measured between the 3rd and 4th ribs. Drip loss was measured from the chop that was cut from *Longissimus dorsi* muscle between the 4th and 8th ribs and then weighed using a Mettler scale and placed in nylon mesh and sealed in a plastic bag.



Figure 2. Hanging carcasses of the pigs and weight measurement using a digital scale

Cortisol concentration was measured using a commercial ELISA kit® (SKGE008, R&D Systems, Inc. Minneapolis, MN, USA). The absorbance of samples and standards was determined using a micro plate reader (Multiskan Ascent, Helsinki, Finland) and a standard curve was generated for from the measurement. Salivary cortisol concentrations were then calculated based on the standard curve. All data were tested for constant variance and departures from normal distribution using the Kolmogorov-Smirnov Test in SAS (SAS, 2004). Least square means of blood glucose, lactate, triglycerides, cortisol, pH of sex and transport duration were generated using the Kolmogorov Test in SAS (SAS, 2004).

Results

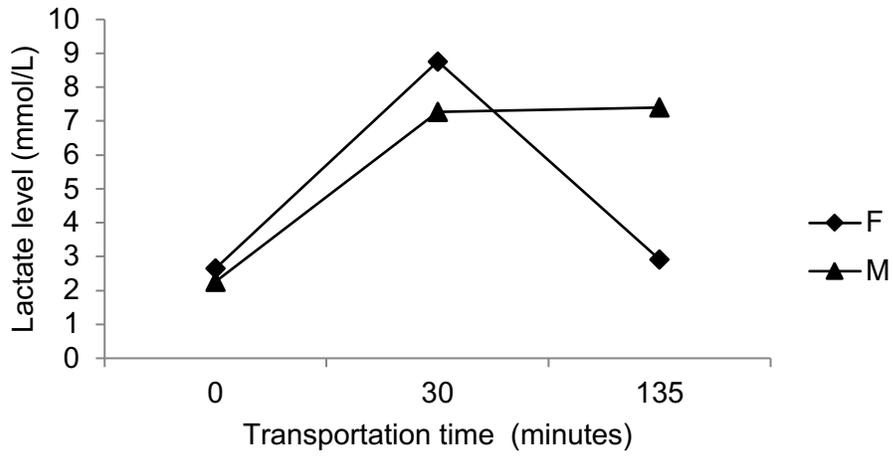


Figure 3 .The relationship between lactate level and transportation time

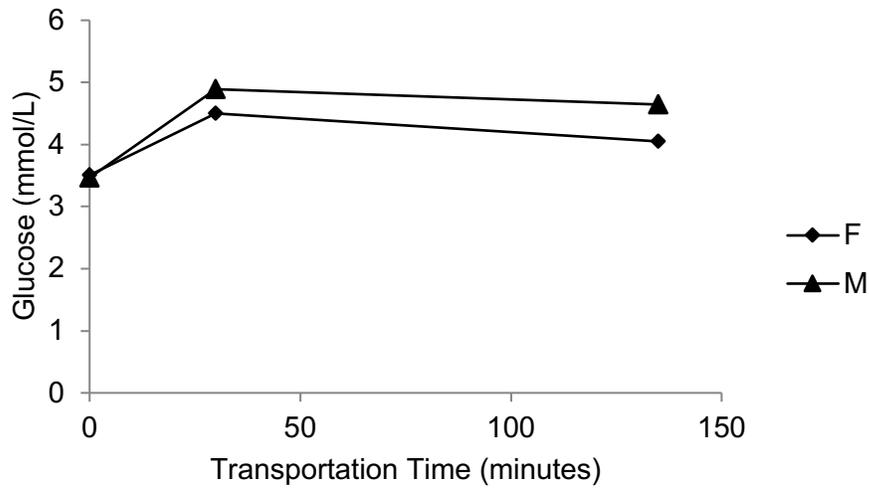


Figure 4 .The relationship between glucose level and transportation time

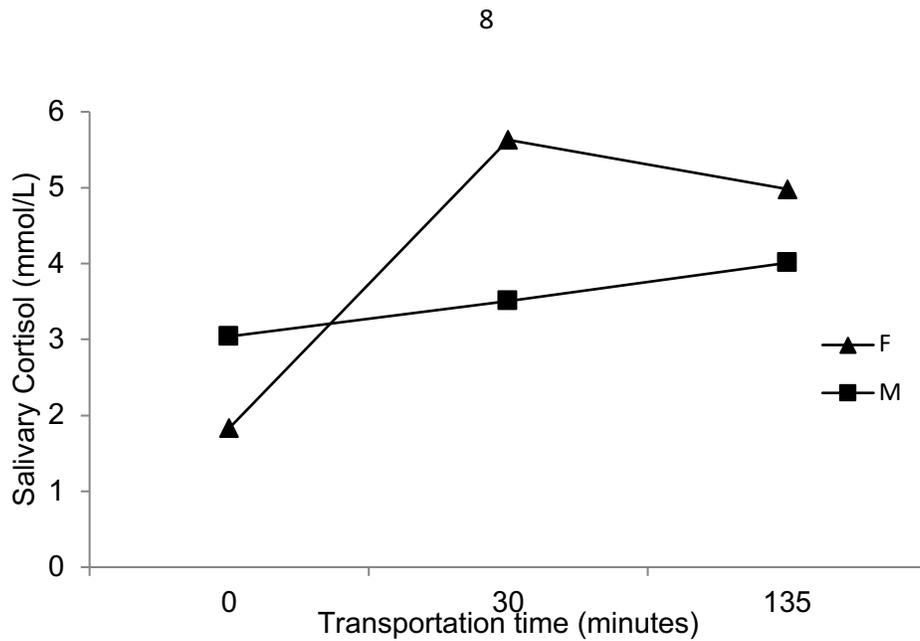


Figure 5. The relationship between salivary cortisol level and transportation time

The blood concentration of lactate increased after the short distance travel and then decreased after the long distance (Figure 3). The rate of decrease was higher in the females than the males so there was interaction between transportation time and gender. There was an increase in the level of glucose in both males and females at the short distance travel and a gradual reduction in the longer distance. There was no interaction in gender and distance as shown in Figure 4. The salivary cortisol level in pigs transported over short and long distances are shown in Figure 5. There was an increase in salivary cortisol levels among the female and male pigs transported over the short distance.

Conclusion

Transportation, both long and short duration, affected the levels of lactate, glucose and salivary cortisol levels and the differences were measured by the POC tests. There were differences on the impact of transport duration on lactate levels and also on the carcass temperature, drip loss and pH. There were relationships between the metabolic substrates and meat quality traits measured in the study. More studies need to be carried out to develop more precise prediction equations under different production and transportation conditions. Point of care devices can be

used to determine the glucose and lactate changes in pigs before slaughter hence they have a potential role in mitigating against poor pork quality due to pre-slaughter stress.

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