GLYCOLYTIC CAPACITY DOES NOT PREDICT THE ULTIMATE PH OF AUSTRALIAN PORK LOIN

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I. INTRODUCTION

The eating quality of Australian pork is highly variable, and this variation negatively impacts consumer satisfaction [1]. Previous work has shown that the negative perception of eating quality in Australian pork is related to low pH [2], which is of considerable concern because the ultimate pH of Australian pork often falls between 5.3 - 5.4. To reduce the variation in eating quality, an understanding of what causes low pH is essential. Recently, England *et al*. [3] concluded that the glycolytic capacity of the muscle dictates the ultimate pH. Greater activity and abundance of Lactate dehydrogenase (LDH) can be used as an indicator of greater glycolytic capacity [3,4], while oxidative muscle types are associated with greater Isocitrate dehydrogenase activity (ICDH) and myoglobin concentration [4]. Domestic pig breeding programs are mostly focused on increasing productivity and lowering costs, meaning that faster growing, highly glycolytic muscled animals are favoured. Thus it is hypothesed that the low ultimate pH of Australian pork is a result of increased glycolytic and decreased oxidative potential in pigs.

II. MATERIALS AND METHODS

A total of 198 entire male pigs carcases produced on the same farm were sampled at a commercial abattoir in Western Australia over 6 different kill days. At 45 minutes post-slaughter a ~5g sample of *m*. *Longissimus Dorsi* (LD) was removed just cranial to the sirloin-loin junction and snap frozen in liquid nitrogen. These samples were analyzed for glycolytic (glycogen at slaughter, LDH) and oxidative (ICDH, myoglobin) potential. The carcases were stored in the chiller at 2^{o}C for 2 days, before a 1kg section of loin was removed and transported to the lab for measurement of ultimate loin pH at 72 hours post-mortem. Data was analysed using proc correlations and a general linear models in SAS® to test the relationship between glycolytic/oxidation potential markers on ultimate pH. Models were adjusted for fat depth and kill day.

III. RESULTS AND DISCUSSION

The activity of LDH and ICDH were not correlated with ultimate pH (R= -0.11, -0.02) and thus could not predict ultimate pH in pork loin. Myoglobin concentration was weakly correlated to ultimate pH (R= 0.26; <0.05), greater myoglobin associated with higher ultimate pH, however this was insignificant when adjusted for kill day. Muscle glycogen concentration at slaughter was highly correlated with ultimate pH (R=-0.6; <0.001), ultimate pH decreasing by 0.2 units across the range of glycogen concentration (Fig. 1). Glycogen levels of > 1.2% (1.2 g/100g) would put carcasses at risk of an ultimate pH of < 5.4 and below. At this pH point, the isoelectric point of myosin is reached, decreasing water holding capacity and reducing meat quality. Of the 198 carcasses sampled, 32.8% had an ultimate pH of 5.4 or below.

Although greater glycogen stores at slaughter reduced ultimate pH, the activity of glycolytic/oxidative markers were not associated with ultimate loin pH, and thus our hypothesis was rejected. These results suggest that low loin pH related to greater substrate concentration than to the total glycolytic potential of the muscle. These unexpected results may relate to different ranges in glycolytic/oxidative potential of Australian pigs. Previous literature has reported LDH activity in the loin of pigs to be around 970 U/g [5], while in the current data the mean activity of LDH was 1359 U/g. England *et al*. [3] found that the influence of glycogen concentration on pH was specific to muscle type; where glycogen concentration influenced ultimate pH in glycolytic type muscles but not in oxidative muscle. While glycolytic muscles can store more glycogen, the failure of glycolytic potential to influence ultimate pH or glycogen stores in this study is likely due to a reduced range in glycolytic potential, particularly at the lower end. Glycogen concentration had a

weak negative correlation with fat depth (R= -0.28; P<0.05), indicating a positive relationship between leanness and glycogen stores and supporting a shift of fibre types from oxidative to glycolytic [6]. While glycogen at slaughter is often an indicator of on farm nutrition and pre-slaughter stress, the low pH of Australian pork may be due to increased selection pressure for faster growing, lean animals. Of these factors, nutrition/stress/genetics, the only practical control point would be to find a genetic balance between growth and meat quality.

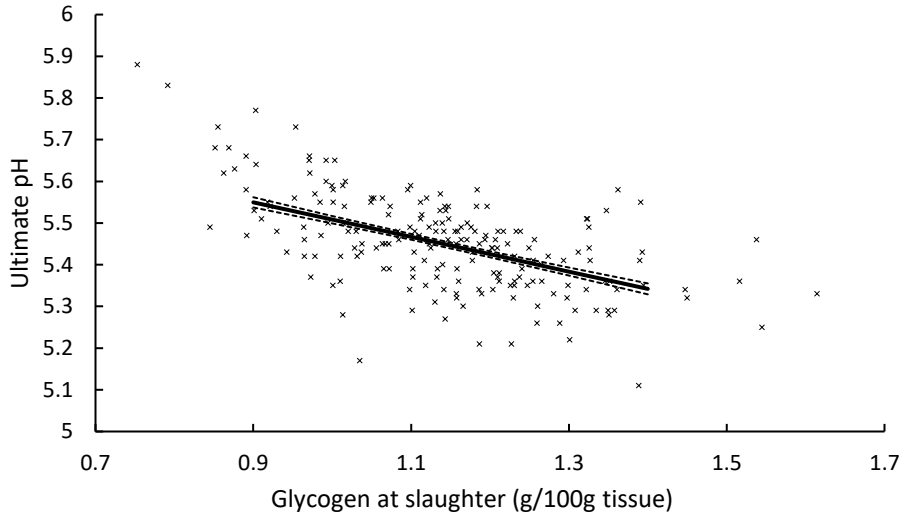

Figure 1. The effect of glycogen concentration in the loin at slaughter on ultimate pH (72h post-mortem). The crosses are raw data points

IV. CONCLUSION

The total amount of stored muscle glycogen was the only significant factor in influencing ultimate pH in Australia pork loin. This may be a result of the over-selection for fast growing lean animals, where the loin is highly glycolytic. These results highlight the impact that selection pressure has on meat quality, and the importance of balancing animal productivity with eating quality.

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REFERENCES

1. Channon, H. A., & Warner, R. (2011). Delivering consistent quality Australian pork to consumer- a systems approach. In Manipulating Pig Production XIII (pp. 262-293), Adelaide, Australia.
2. Jose, C. G., Trezona, M., Channon, H. A., & D'Souza, D. N. (2013). Eating Quality Linked to Ultimate pH and Tenderness in Australian Fresh Pork. In Manipulating ig Production XIV. Melbourne, Australia.
3. England, E. M., Matarneh, S. K., Oliver, E. M., Apaoblaza, A., Scheffler, T. L., Shi, H., & Gerrard, D. E. (2016). Excess glycogen does not resolve high ultimate pH of oxidative muscle. Meat Science, 114:95-102.
4. Gardner, G. E., Hopkins, D. L., Greenwood, P. L., Cake, M. A., Boyce, M. D., & Pethick, D. W. (2007). Sheep genotype, age and muscle type affect the expression of metabolic enzyme markers. Australian Journal of Experimental Agriculture, 47:1180-1189.
5. Reig, M., Aristoy, M. C., & Toldrá, F. (2015). Sources of variability in the analysis of meat nutrient coenzyme Q10 for food composition databases. Food Control, 48:151-154.
6. Ryu, Y. C., & Kim, B. C. (2005). The relationship between muscle fiber characteristics, postmortem metabolic rate, and meat quality of pig longissimus dorsi muscle. Meat Science, 71:351-357.