3C-104: Enhancing the Iron content of pork to promote human health benefits

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Background, Methodology and Key Findings

The iron (Fe) content of pork meat is low in relation to lamb and beef, and currently, Australian pork does not meet the Australian Food Standards Code requirements of being a food that is "a good source" of Fe. Three experiments were conducted to test the propositions that (i) pigs raised in deep-litter systems will have more Fe and myoglobin than their counterparts raised indoors (conventional); (ii) feeding diets lower in Fe (to induce mild iron depletion) followed by feeding diets higher in Fe (to induce Fe repletion) will increase muscle Fe levels; and (iii) there will be differential expression of candidate genes implicated in muscle Fe metabolism in response to (ii).

Experiment 1 measured mineral and myoglobin levels in samples of muscle (*longissimus dorsi,* LD; and *rectus abdominus,* RA) from female pigs grown indoors or on deep-litter that were slaughtered at either 7, 10, 13, 16, 20, 24, 26, 30 or 35 weeks of age. There was no housing effect on Fe, Zn or myoglobin contents. The RA was higher in Fe, Zn and myoglobin than the LD. In Experiment 2, female pigs were fed one of two grower diets for 8 weeks that differed in Fe content (High or Low; 239 *vs* 50 ppm) followed by a cross-over design for 7 weeks of further feeding, with half of the High pigs fed a high Fe (248 ppm) finisher diet (High-High) while the other half were fed a low Fe (71 ppm) diet (High-Low). The same design was applied to the Low Fe grower pigs, to create Low-High and Low-Low treatment groups, respectively. Blood samples were obtained through the grower-finisher stages. Pigs were killed commercially at the end of the grower and finisher stages with muscle [*m. longissimus dorsi* (LD) and *m. rectus femorus* (RF)] and organ (liver, heart) samples obtained. Increases in Fe content were only found in the RF at the end of both the grower and finisher stages in response to feeding diets High Fe and Low-High, respectively. Increases in RF Fe content in diet Low-High supports the dietary depletion/repletion model of action. There were no deleterious effects on production indices. Pigs fed diet High-High had less P2 than pigs fed diet Low-High. Muscle LD from High pigs was darker and redder than in pigs fed Low Fe (end of grower), and pigs fed High-High (end of finisher) had redder meat in the LD. The liver, but not the heart, stored Fe in pigs fed diets High and diets Low-High and High-High. Experiment 3 investigated the expression of some candidate genes involved in Fe metabolism and physiological regulation in both the LD and RF muscles at both the end of the grower and finisher stages. Findings confirmed blood and muscle results in Experiment 2, and underscored the physiological regulation of Fe metabolism in muscle. For example, ferroportin levels (ferroportin is a transmembrane protein that transports iron from the inside of a cell to the outside of it) supported the higher Fe concentration in muscle RF and indicated an increased excretion of iron from this muscle.

Data obtained from this project using this particular nutritional manipulation model indicated that it was not possible to manipulate the amount of Fe contained in all muscles of the pig. The redder RF was more responsive to the depletion-repletion model, however and as evidenced by blood Fe, ferretin and haemoglobin levels, the grower-finisher pig has tremendous homeostatic propensity to buffer 3- to 4-fold differences in dietary Fe intake to avoid deficiency or overload.

Recommendations

1. There is no benefit in feeding additional dietary Fe to increase its content in muscle, except possibly where there might be a specific market niche for higher Fe pork, in which case redder muscle types will deposit more Fe is given in excess.
2. The liver acts as a storage organ for surplus Fe absorbed by the pig.
3. Dietary Fe levels in young pigs should be re-examined to eliminate the possibility that over supply of dietary Fe early in life is not having a detrimental affect on Fe absorption (and hence deposition in muscle) later in life.
4. The decrease in P2 at slaughter at finishing in pigs fed diet High-High compared to pigs fed Low-High warrants further examination.

Potential Users of Information (including value assessment)

Potential users include pork producers/processors looking to differentiate product, but low value assessment.