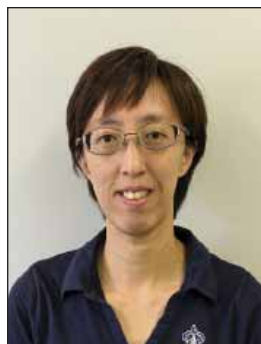


Improving feed efficiency in pork production through individual thermal efficiency index

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INSIGHT FOR PRODUCERS

Feed efficiency is not equal among all pigs. Measuring thermal output in relation to feed efficiency may support selection practices for genetic companies, resulting in more efficient pigs, reducing feed costs and increasing profits.

SUMMARY

Feed efficiency is essential in pork production optimizing growth and maximizing nutrient use. This project will validate the use of thermal efficiency index (TEI) for evaluating feed efficiency in growing pigs. This study investigated the relationship between thermal efficiency and stress resilience. In a 2 x 2 design, weaner pigs were assessed for TEI, with high and low TEI animals selected; half of each group received a commercial supplement in water (DSS, designed to reduce stress) for 24h before and after stressful events, and half were treated as control. Pigs were challenged with a controlled handling and mixing stressor at 12 and 16 weeks respectively. Infrared temperature was evaluated before and after each stressor with additional salivary cortisol and thermal imaging measurements in the second replicate. TEI shows a consistent correlation with average daily gain, which indicates a valid metric for measuring pigs' growth. Use of DSS in water significantly reduced lesion scores at mixing compared to the control and produced a greater change in TEI in response to handling and mixing stressors.

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INTRODUCTION

Feed efficiency is variable with 'inefficient' animals wasting more energy by giving off more heat than efficient animals, and/or absorbing less energy from feed and releasing unused nutrients to the environment. The thermal output of animals is thus a potentially useful measure for estimating feed efficiency. Infrared thermography can assess thermal output in real time and shows many other technical and practical advantages. The procedure is non-invasive and can be used to rank an animals' efficiency in approximately 20 seconds. The technology has also been patented, beta site tested, and is now entering use in commercial facilities. Further work is needed to validate TEI as a tool in swine production, including for example knowledge on relationships between TEI and stress resilience, the effects of different diet formulations on TEI, heritability of TEI, as well as relationships with susceptibility to heat stress and pig temperament.

The application of thermal profiles will be of particular benefit to genetic companies. By facilitating the early selection of pigs on the basis of efficiency, faster genetic progress can be achieved.

Because TEI can be measured in early life, the application of infrared technology and thermal profiles could also benefit pork producers. If young pigs can be sorted based on feed efficiency at the weaner or grower stage, diets can be prepared based on the different needs of each group. With thermal classification, each group of pigs would be provided a diet nutritionally tailored to better meet their needs, resulting in improved efficiency.

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EXPERIMENTAL PROCEDURES

This study followed a 2 X 2 factorial approach with two TEI categories (HIGH and LOW) and two nutritional therapy treatments: Control (CTR) and treated (DSS). The DSS treatment utilized a nutritional therapy is a recently registered Veterinary Health Product. This product is delivered through drinking water to pigs and is demonstrated to attenuate the impacts of stress induced protein catabolism, electrolyte depletion, hyperactive HPA activity, hypoglycemia and dehydration.

The study utilized 176 pigs in two replicates (88 pigs per replicate). Pigs were enrolled one day before nursery exit (8 weeks of age) and scanned using an infrared camera to

determine TEI (mean dorsal temperature/body weight \times 0.75). In each replicate, 44 pigs with high TEI ("HIGH": TEI 4.29 ± 0.39 ; body weight 15.62 ± 1.43 kg) and 44 with low TEI ("LOW": TEI 3.48 ± 0.35 ; body weight 20.28 ± 1.82 kg) were selected and housed at 11 pigs/pen. Pens were randomly assigned to nutritional treatment, with four pens of 11 pigs per treatment category over two replicate studies. The study was partitioned into Grower (8-12 weeks of age), Finisher 1 (12-16 weeks) and Finisher 2 (16-20 weeks) phases, with TEI and body weight recorded at the end of each phase to determine average daily gain (ADG). Individual feed intake was recorded daily using automated feeders to determine average daily feed intake (ADFI) and Gain: Feed (G: F). Pigs were marketed at 20 weeks of age and carcass grading data was obtained.

The impact of two forms of stress were evaluated: handling stress at 12 weeks of age and mixing stress at 16 weeks. For the handling and mixing events, pigs in the DSS treatment received the nutritional therapy delivered in water for a total of 48h, from 24h before the stressor until 24h after.

Handling stressor

At 12 weeks of age, pigs underwent a controlled handling treatment, with thermal profile recorded pre and post-handling, and behavioural measures recorded during handling. Pigs were guided to the hallway and then moved along the corridor in groups of 5 or 6 animals for a total distance of approximately 90 meters, while observations of the pigs running, walking or standing, and vocalizing were recorded. In order to further understand the impact of TEI on recovery from stress, salivary cortisol samples were collected pre- and post-handling in the second replicate. Additional thermal imaging was also conducted using a handheld infrared camera, recording at 5, 10, 15 and 30 minutes post-handling.

Mixing stressor

At 16 weeks of age, pigs were mixed into pens with unfamiliar pigs. Mixing is an acute social stressor for pigs which typically results in aggression as the pigs compete to establish their social rank within the group. For each pen, 5-6 animals were moved to a pen of pigs within the same TEI and treatment category. After two hours the pigs were returned back to their original pen in order to minimize potential long-term damage due to fighting. Thermal profile was recorded before and after mixing. Behavioral measures during the mixing event and lesions were assessed as measures of aggression. Body lesions were scored before and after mixing using a four-point scale (0 = none; 3 = \geq 11 lesions). In the second replicate, additional measures were taken as with the "handling stressor".

RESULTS AND DISCUSSION

As the nature of TEI calculation considers body weight, we were not able to perfectly balance the body weight at entry. At weaning age, the greater feed efficiency of LOW animals resulted in higher body weights compared to HIGH animals. The average baseline weight for LOW pigs was almost 5kg heavier than the average for HIGH pigs (20.28 ± 1.82 kg vs 15.61 ± 1.43 kg, $P < 0.001$). Average weight at trial entry did not differ between dietary treatment groups. LOW pigs tended to have a higher ADG from 8-12 weeks. During Finisher 1, LOW pigs consumed more feed and had greater ADG with no difference

in G:F. During Finisher 2, there was no difference in ADFI, ADG or G:F between TEI categories. The overall ADG throughout the grower-finisher stage was greater for LOW than HIGH pigs. LOW pigs had greater slaughter weight, and fat (mm). There was no effect of TEI on loin depth.

During handling at 12 weeks, DSS tended to affect the change of TEI (Δ TEI), with pigs given DSS showing greater change (Figure 1). In the mixing stressor at 16 weeks test, DSS pigs showed a greater Δ TEI than CTR pigs, with no effect of TEI category (Figure 2). Thermal efficiency and DSS treatment did not affect behaviour during handling. DSS treatment affected lesion scores at mixing: CTR animals received more head lesions and tended to have more mid-body lesions compared to DSS. TEI category tended to influence hind-end lesions; scores of HIGH pigs showed less change than LOW.

In terms of the relationship between thermal efficiency index and bodyweight, a linear correlation was detected. Initial TEI and bodyweight were negatively correlated, similarly at week 12, which means that pigs with lower TEI were consistently heavier. Interestingly, in week 12 after the handling stress, the correlation decreased, which suggests that pigs' body temperature was indeed disrupted by the handling stress process. Similar results were found at week 16 before the mixing stress and after.

IMPLICATIONS

The findings based on thermal efficiency alone exhibit that TEI can be used to identify pigs with better performance in terms of weight gain and carcass yield. Based on data from the beginning of the trial, at week 12, and at slaughter, there was a negative correlation between TEI and bodyweight, with LOW pigs being heavier at each point. Both handling and mixing stress decreased the extent of this negative correlation, exhibiting the physiological influence of stress.

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