Temperament Traits Related to Stress and Meat Quality: Are they Reliable and Heritable?

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SUMMARY

This project evaluated different behavioural tests for their ability to accurately determine temperament traits related to the stress response of pigs, and determine: whether these traits are consistent within individual pigs over time, and if they are heritable. Results found evidence that supports the use of simple behavioural tests to distinguish between temperament traits in pigs.

Correlations between the behavioural responses of gilts measured at two different time points (12 and 18 weeks of age) were evident in both the 1st generation and in 2nd generation offspring, indicating consistency of these traits within individual pigs over time. Temperament classifications of individual pigs were also correlated to the concentration of saliva cortisol following handling and following mixing in 1st generation gilts. The analysis of temperament heritability is ongoing, with the initial results suggesting that pigs could be selected for reduced stress response. Further studies with larger numbers of animals would be needed to determine the full merit of these tests as a selection tool.

INTRODUCTION

The susceptibility of pigs to stress can significantly influence their welfare, and in turn can also affect their productivity, ease of handling and stockperson labour required to move them. The stress caused during transport and handling of pigs at marketing can result in severe losses for both producers and packers, resulting in in-transit death losses, carcass damage and reduced meat quality (eg. increased incidence of PSE pork).

Individual differences are known to exist in pigs, with these differences in temperament being shown to significantly affect the way pigs handle stressful situations and their subsequent meat quality. The heritability of temperament traits is believed to exist in pigs, however the level of heritability found by studies has been shown to vary from moderate to weak. If future breeding stock could be selected on the basis of temperament tests and their relation to stress response, it would be possible to select over time for reduced levels of stress in both parents and offspring.

The overall objective of this work was to assess the temperament of pigs using practical, on-farm behavioural tests and to establish links between temperament classification, stress response and the subsequent heritability of behavioural traits. To achieve this goal, specific objectives were to:

1) Conduct a thorough evaluation of the methods for assessing pig temperament that can be applied on commercial farms. This evaluation included an assessment of:
   - i) The reliability of each test (consistency over time)
   - ii) The relationship between temperament (as indicated by behavioural tests) and the stress physiology of pigs in response to handling, and
   - iii) The heritability of temperament traits (ie. do they respond to selection?).

"Stress caused during transport and handling of pigs at marketing can result in severe losses for both producers and packers"

EXPERIMENTAL PROCEDURE

The study was conducted in two phases and used a total of 521 animals.

Phase I.

Testing and selection of 1st generation gilts for breeding.

Behavioural testing: Over a 16 month period, a total of 276 gilts were evaluated in behavioural and physiological tests at 12 and 18 weeks of age. Four behavioural tests were used to assess the temperament of gilts. A brief description of the tests is as follows:

The open-door test (ODT): Four to six pigs are placed in a pen, and given 5 minutes to acclimatise. The pen door is opened and the latency for each pig to exit the pen recorded, to a maximum of three mins. Pigs that rapidly exit the pen can be described as 'active', while those that are reluctant to exit are 'passive' (Figure 1).

Human approaching pig test (HAP): One pig was placed in a test pen. A human entered the pen and approached the pig slowly (Figure 2). An observer scored the response on a scale of 1-4 relating to how the pig responded. For example: 1= pig appears fearful, moves away rapidly or 4= pig not fearful, interacts with human. Pigs with a high HAP score (e.g. 4) can be described as 'confident', while those with a low score (e.g.1) are 'fearful'.

Pig approaching human test (PAH): One pig was placed in a test pen. A human entered the test pen and stood in a predetermined location. For up to a maximum of three minutes, the latency of the pig to make contact with the human, the number of contacts made, and the duration of time spent within one meter of the human recorded. Pigs with a shorter latency to contact the human are described as 'confident', while those with a longer latency, or no contact at all are described as 'fearful.'

The novel object test (NOT): One pig was moved into a test pen with three objects (Figure 3). One observer outside the pen recorded the latency for to make contact with the first object, the number and duration of contacts with each object, and the number of times the pig switched between objects. Pigs that were quick to make contact and switched objects frequently are described as 'active', while pigs that were slower to contact the objects, but spent more time exploring each object are described as 'passive.'

Eighty-one gilts which showed extremes of behavioural response in tests, i.e. in passive/confident and passive/fearful phenotypes, were selected (forming the 1st generation) for breeding and heritability studies. The response of the bred gilts to mixing was evaluated during gestation.

Physiological testing: Following behavioural tests at 18 weeks of age, the 81 selected gilts were subjected to a standardized handling test to evaluate their physiological response to a stressor. The handling test involved walking a pig around the corridor of the room for a distance of 100m. The total time taken, the handling responses of the pig (balks, attempts to turn back, vocalizations), and the actions required by the handler to keep the pig moving were recorded. Prior to the test gilts were fitted with heart rate monitors and salivary cortisol samples were collected using cotton swabs before handling and at 10 and 40 minutes after the handling stressor.

Phase II.

Heritability of Temperament

Progeny of the 81 selected 1st generation gilts were reared under standard management conditions. A total of 250 gilts (three from each litter, forming the 2nd generation), were reared to market weight and subjected to the same behavioural testing at 12 and 18 weeks of age. Similar to their dams, the progeny were also tested with the standardized handling protocol at 18 weeks of age.

Figure 1. Sow exiting the pen in the open door test.

Figure 2. The human approaching pig test.

RESULTS AND DISCUSSION

Correlations between temperament tests:

Within each generation of pigs tested, significant correlations were found between responses to the HAP, PAH and NOT tests at 12 and 18 weeks of age however, there were not any correlations between ODT measures. The positive correlation of behavioural responses to tests conducted at two time points provides evidence that the tests measure traits that are consistent within individuals over time, and demonstrates the validity of these tests as a measure of temperament (personality). The HAP and PAH are considered as tests related to confidence and fear in pigs, especially as these tests involve responses to human interaction. Fear related to humans is arguably the most relevant stressor in swine production. The NOT measures the pigs' innate exploratory response to a novel object, and is considered a measure of active/passive traits. The failure of the ODT to show significant correlations over time may relate to changes in the response of pigs over time as they mature.

Temperament classification:

Factor analysis of the behavioural responses in each of the temperament tests was performed, and confirmed that HAP and PAH tests assess traits related to confidence and fearfulness, and

that ODT and NOT tests assess active and passive traits. Based on their response to the tests, each pig was assigned a score weighing their temperament for active/passive and confident/fearful dimensions.

Relationships between pig behavioural response to handling and stress response:

Within the 1st generation, there were no correlations between the saliva cortisol measures taken before and after handling and the behavioural response of the pigs to handling. The lack of significant relationships could be due to the smaller number of pigs studied for this generation, and there were also several missed measures which hindered our ability to determine significant relationships. In the 2nd generation there was a greater number of pigs were studied. Here the total number of aversions (balks and turn backs) displayed during handling was positively correlated to the average and maximum heart rate, and to the average concentration of cortisol measured 40 minutes after handling. Together, these results indicate that the more aversions displayed by a pig, the greater the stress experienced, as indicated by elevated heart rate and cortisol concentration. The relationships between the pig's behavioural response to handling and physiological measures of stress suggest a causal relationship. Elevated heart rate in response to handling, indicates arousal of the sympathetic nervous system (stress response), and elevated concentrations of cortisol following handling has been found to be related to negative handling experiences.

Relationships between temperament and stress response in 1st generation gilts:

In the 1st generation gilts, the average cortisol concentration measured 40 minutes after handling was negatively correlated to the active/passive temperament scores, as determined from tests at 18 weeks of age, indicating, that pigs with more active temperament traits had higher levels of cortisol following handling. Similarly, a positive correlation was found between the change in salivary cortisol concentration from samples taken before and after handling, and the active/passive temperament scores determined from tests at 18 weeks, with this result also suggesting a larger change in cortisol in pigs with active temperament traits.

Differences in the endocrine response in relation to different temperament coping styles have been explored previously, and it has been found that pigs described as having an active coping style have a lower HPA activity, including lower cortisol responses, than pigs classed as passive, however this differs from the relationship found in this study. The difference in findings may be linked to differences between basal concentrations in cortisol, and cortisol released in response to a stressor.

Figure 3. Novel objects presented in the novel object test. .

Calm/fearful temperament scores at 12 weeks of age were negatively related to the concentration of salivary cortisol measures taken 72 hours after mixing. In addition, the calm/fearful temperament scores at both 12 and 18 weeks of age were positively correlated to the change in cortisol concentration from pre- to post-mixing. This indicates that pigs with fearful temperament traits (lower scores) had a greater increase in cortisol concentration at mixing.

Analysis to determine the temperament scores for the 2nd generation gilts is in progress, and will help to confirm the association between stress responses and pig temperament. The analysis of heritability between 1st and 2nd generations is ongoing.

CONCLUSIONS

The results of this study are preliminary, but offer evidence to support the occurrence of distinct temperament traits in pigs and the relationship between temperament and the stress response. The results also indicate that tests measuring pigs' response to humans (HAP and PAH tests) provided the most accurate assessment of the fear response, while the ODT and NOT appear to measure different responses related to active/passive traits. The results of this study are encouraging, and suggest that pigs could be selected for reduced stress response on the basis of temperament tests. Further analysis is needed to better identify and distinguish the traits associated with these tests and interactions with previous experience. For the future, a larger study, ideally with the inclusion of additional stress testing and meat quality analysis would be beneficial to determine the full merit of these tests as selection tools for improved pork production.

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