Pig behaviour in novelty test relates to serotonergic brain-blood parameters.

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The objective of this study was to examine the relationship between the behavioural response of pigs in a novelty test and brain-blood parameters of serotonergic activity. Maladaptation (reflected in e.g. tail biting) is often related to suboptimal environmental conditions. However, individual differences in adaptive capacity may also play a role in the development of maladaptive responses. In both humans and animals, serotonin (5-HT) levels and Monoamine Oxidase activity (MAO) in the body are found to be related to maladaptation (e.g. depression, OCD). Here, we assume that individual behavioural characteristics may predispose pigs to exhibit such maladaptive responses, and we therefore hypothesized that behavioural responses of pigs in a stressful situation might be related to 5-HT levels and MAO in blood and brain. If such a relationship exists, 5-HT levels and MAO may represent useful markers of individual differences in adaptive capacity in pigs.

Pigs (n=32) were kept in barren or enriched pens in groups of four. At 11 weeks of age, pigs were subjected to a 10-min novelty test. The pigs were individually placed in a novel arena and after 5 min a novel object (bucket) was introduced. Behavioural responses were recorded and clustered in the continuous behaviours ‘locomotion’, ‘exploration’ and ‘inactivity’, and in the behavioural events ‘high-pitched vocalizations’ and ‘low-pitched vocalizations’. Blood was taken at 13 and 19 weeks. 5-HT content of blood platelets and blood MAO in blood were measured at 13 and 19 weeks and 5-HT uptake in blood platelets at 19 weeks. Brains were collected at 19 weeks and 5-HT turnover was determined in the Frontal Cortex, Hippocampus and Hypothalamus. Statistical analysis was performed by Pearson correlations on the residuals of a model with housing as a fixed effect.

Locomotion, exploration and inactivity in the first five min of the test were not significantly correlated with brain-blood parameters. Frequency of high-pitched vocalizations was positively correlated with 5-HT turnover in the Hypothalamus (r=0.40) and negatively correlated with MAO (week 13; r=-0.49). 5-HT uptake in blood platelets was positively correlated (r=0.40) with low-pitched vocalizations. Exploration (r=0.67), inactivity (r=-0.44) and moving (r=0.44) after introduction of the novel object, were all correlated with 5-HT turnover in the right Hippocampus. 5-HT content in blood platelets (week 13) was positively correlated (r=0.48) with exploration. MAO (week 19) was correlated (r=-0.37) with inactive behaviour and moving (r=0.37). No significant correlations were found between vocalizations and brain-blood parameters after introduction of the novel object.

The behavioural response of pigs in a novelty test is related with serotonergic brain-blood parameters. Depending on the phase of the novelty test (either without or with novel object) there were differences in correlations between behaviours and brain-blood parameters. In the first part, pigs with a higher 5-HT uptake displayed more low-pitched vocalizations. The more high-pitched vocalizations were observed, which may indicate fear, the higher the 5-HT turnover in the Hypothalamus was, and the lower MAO. In the final part of the test, higher exploration and moving, and lower inactivity, probably reflecting lower fear levels, were associated with higher 5-HT turnover levels in the Hippocampus. The more exploration was observed, the higher the 5-HT content of blood platelets was, and more moving and less inactivity was observed when MAO was higher. Possibly, behavioural

responses to different phases of the test reflected different underlying behavioural characteristics, with differential relationships with brain and blood 5-HT and MAO. The next step is to discover if the identified relationship between behaviour and brain-blood parameters are related to maladaptation in pigs under commercial pig husbandry conditions.