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Responses of pigs divergently selected for cortisol response or feed efficiency to an ACTH challenge

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Selection for feed efficiency can impair the animal's ability to respond to stress. A key driver of this response is the hypothalamo-pituitary-adrenal (HPA) axis, which releases cortisol in response to stressors. Injection of a normalized dose of adrenocorticotrophic hormone (ACTH) to stimulate cortisol release by the adrenal cortex is a standardized method to evaluate the activity of the HPA axis independently of the animal's perception of stress. It has been used to select during three generations a highCortisol line and a lowCortisol line, that had divergent cortisol levels 1 h after ACTH injection (H1, peak of the response). A trial was set up to compare the responses to ACTH of these two lines and those of two other lines divergently selected for residual feed intake (RFI, measure of net feed efficiency) during nine generations. At 6 weeks of age, 48 pigs per line were tested. Blood samples were collected before and 1 (H1) and 4 h after injection (H4) when cortisol is expected to return to basal level. In the Cortisol lines, plasma cortisol was multiplied by 2 ($P < 0.0001$) in highCortisol pigs compared to lowCortisol pigs at the 3 times. In both lines, cortisol was multiplied by 2.3 to 2.6 at H1 compared to H0. The highRFI (less efficient) line had a similar response to the ACTH injection as the Cortisol lines. The lowRFI line had higher cortisol levels at H0 ($P = 0.08$) and H1 ($P = 0.0002$) than the highRFI line. This difference was increased at H4 ($P < 0.0001$), due to higher H4 than H0 cortisol levels in lowRFI pigs ($P < 0.0001$). Blood counts, urea, glucose, IGF-I and free fatty acids (FFA) measurements were used to better understand the responses to ACTH, suggesting different underlying metabolisms. In contradiction with previous hypotheses, increased feed efficiency is not associated with a decreased HPA axis activity, but might be related to different dynamics of responses after stress. This study is part of the Feed-a-Gene Project, funded from the European Union's H2020 programme under grant agreement no. 633531.