

The Run of Depression Resilience Phenotype from a Natural Disease Challenge Model for Wean-to-Finish Pigs

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Austin M. Putz, Ph.D. Student, ISU;
John C. S. Harding, Professor, University of Saskatchewan
Michael K. Dyck, Professor, University of Alberta
PigGen Canada, Guelph, ON, Canada
Frédéric Fortin, CDPQ, Québec City, QC, Canada
Graham S. Plastow, Professor, University of Alberta
Jack C. M. Dekkers, Distinguished Professor, Iowa State University

Summary and Implications

Resilience phenotypes will be needed in the future as livestock industries adopt precision agriculture technology on a large portion of commercial animals. The current study introduces a run of depression (ROD) phenotype to quantify resilience using individual daily feed intake data. This phenotype was lowly heritable (0.11 ± 0.07) but was genetically correlated to mortality (0.75-0.98) and treatment rate (0.61-0.84).

Introduction

Currently, precision agriculture is on the rise in agronomy and animal sciences. Precision technology in animals has been implemented in all major species, with dairy leading the way with rumination sensors, activity monitors, and robotic milking systems, among other technologies. The main goal of many of these technologies is to detect issues early and help determine the correct action to mitigate the issue at hand, such as a disease outbreak. An alternative use is to retrospectively analyze this high-density data to extract phenotypes that are indicators of resilience and other traits such as reproduction.

Materials and Methods

Data and natural challenge protocol: Data from the first 2,273 Large White x Yorkshire castrated weaner pigs from PigGen Canada (<https://piggenCanada.org>) multipliers that were placed into a natural disease challenge model established in Québec, Canada. Batches of ~60-75 weaned pigs from a single source were sent every 3 weeks in this study. The natural disease challenge model consisted of the following three stages: i) a quarantine nursery for the first 19 days after weaning, ii) a challenge nursery between ~40 and ~70 days of age, and iii) a finishing phase between ~70 and ~180 days of age. The latter two phases were diseased challenged by initially introducing four groups of diseased commercial pigs into the facility and then using a continuous flow system to maintain the disease challenge.

Phenotypes: Traditional resilience phenotypes included mortality (0/1) and treatment rate. Treatments were converted to a rate per 180 days (Trt_{180}) to standardize to the average age at slaughter. Other phenotypes included finishing ADG (**FinADG**), average daily feed intake (**ADFI**), feed conversion ratio (**FCR**), carcass weight (**CWT**), carcass backfat (**CBF**), and carcass loin depth (**CLD**).

Feed intake: Individual feed intake data (using electronic tags) were collected using the IVOG® feeding station (Insentec, Marknesse, The Netherlands). Data from individual visits were aggregated into daily sums. There were 1933 animals that had at least one day of feed intake recorded.

Run of depression (ROD) phenotype: The run of depression (**ROD**) phenotype stems from statistical process control (SPC) methods. A 0.50 (median) quantile regression (QR) of feed intake on age was fitted for each animal independently and stretches of consecutive days below the regression line were considered to be a run of depression (ROD). Minimum consecutive lengths of 5, 7, 9, 11, 13, and 15 days was used in this study. Figure 1 shows an example for minimum 9-day ROD lengths for one animal. For each animal, the percentage of days during the finishing period that fell in a ROD was then computed and used as the ROD phenotype. Only animals with at least 60 days of feed intake recorded ($n=1,698$) were used for analysis.

Results and Discussion

The ROD phenotype was low to moderately heritable, ranging from 0.05 to 0.11. Minimum lengths of 5 and 7 days resulted in the highest heritability estimates. Genetic correlation estimates with mortality ranged from 0.75 to 0.98 and were largest with a minimum length of 13 days ROD. Genetic correlation estimates with treatment rate ranged from 0.61 to 0.84, with a maximum reached with a minimum length of 11 days.

Estimates of genetic correlations of the ROD phenotypes with FinADG, FCR, and CBF. Genetic correlation estimates were all negative with FinADG (-0.50 to -0.27) and all positive with FCR (0.18-0.42). Genetic correlation estimates with CBF were slightly negative but close to zero (-0.21 to 0.02).

These results show that the ROD trait can be used to effectively quantify resilience in growing pigs based on individual feed intake data. More research will need to be completed in the future using precision agriculture data for other species and types of data.

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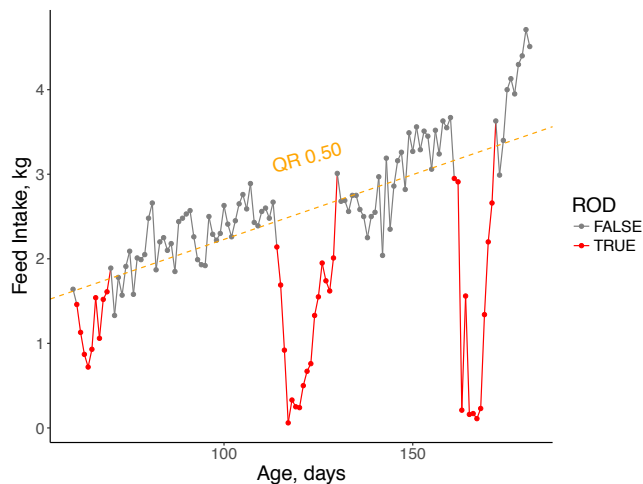


Figure 1. Example of a run of depression (ROD) for animal 0042 with 9 days required to be considered a ROD. Days that consecutively fall below the 0.50 (median) quantile regression line are considered a ROD. These days (in red) are summed and divided by the total number of days and converted to a percent, resulting in one ROD phenotype for each animal.