

ANIMAL SCIENCE

Title: Identification of biological factors responsible for differences in feed efficiency between selection lines for residual feed intake – **NPB #07-161**
Selection lines to enhance genetic selection for feed efficiency – **NPB 07-139**

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SCIENTIFIC ABSTRACT

Understanding the biology behind genetic differences in feed efficiency is important to develop selection strategies to improve efficiency. To this end, a line of Yorkshire pigs selected for lower residual feed intake (RFI) was developed, along with a contemporary control line. The objective of this project was to evaluate the 5th generation of these two lines to identify the main biological factors that contribute to differences in RFI. Specific objectives were to evaluate differences in 1) feeding and pen behavior, 2) meat quality, 3) maintenance or static body weight requirements, 4) and body composition and energy partitioning. Three animal experiments were conducted. In experiment 1, a total of 192 gilts from generation 5 of the Select and Control lines (96 per line) were housed in 12 pens (16 gilts per pen, 8 from each line) in a conventional grow-finish unit with one single-space electronic FIRE feeder per pen. Pigs were evaluated for pen and feeding behavior and, following slaughter, for meat quality. In experiments 2 and 3, eighty young (~25 kg) and 80 older (~75 kg) barrows, with equal numbers from the two lines, were individually penned and allocated to one of four feed intake groups for six weeks: 1) ad libitum, 2) 75% of feed intake of adlib, 3) 55% of feed intake of adlib, and 4) a weight stasis group, in which intake was adjusted to maintain initial body weight. Pigs were evaluated for growth, feed intake and ultrasound, and blood sampled. Upon completion of the performance study, a total of 64 young and 64 old pigs were harvested, organ and carcass weights recorded, and tissues were collected. Chemical carcass composition was determined on one half of the carcass. In experiment 1, for pen behavior, on the day of placement there were no differences between lines for time spent at the drinker or for any postures in the home pen; however, Select gilts had lower lesion scores. Behavioral differences were identified between lines over subsequent rounds, with gilts from the Select line becoming less active compared to Control line gilts but there were no differences in lesion scores. For feeding behavior, even after correcting for differences in feed intake, pigs from the Select line were found to spend less time eating and to eat faster. This result was consistent in direction across three separate data sets. Differences in meat quality between the lines were small, but carcasses from the Select line tended to have less backfat, greater loin depth and a greater percentage fat free lean. Select line chops tended to have greater water holding capacity, less intramuscular lipid content, lower subjective marbling scores, and a greater percentage of moisture. Pigs selected for reduced RFI consumed less feed for the same rate of gain but differed in carcass composition, indicating differences in the partitioning of energy and

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nutrient retention, with limited changes in growth rate but some increase in dressing percentage. Select line pigs also had lower viscera weights and required less energy to maintain body weight, indicating possible differences in maintenance requirements. Selection for low RFI has also resulted in lower Na^+ , K^+ -ATPase activity in the longissimus dorsi, which may contribute significantly to the observed improvements in feed efficiency and lower metabolic rates. In conclusion, although a substantial part of differences in feed efficiency as measured by RFI are related to differences in body composition, part of the differences appear related to pen and feeding behavior and to lower maintenance requirements, protein turn over rates, and ion pump expenditures in muscle. Also, selection for RFI does not have major negative effects on meat quality. However, the molecular mechanisms behind these changes are not fully understood and need to be further examined to obtain greater efficiency gains in livestock.