RESEARCH ABSTRACT

pork checkoff

ANIMAL WELFARE

Title: Automating Detection of Social Behavior Phenotypes and Improving Modeling of Indirect Genetic Effects to Breed for Less Aggression in Group-Housed Pigs **- NPB#17-023** revised-2

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Scientific Abstract

The overall goal of this project was to improve the profitability of pork production through improved pig well-being, by using phenomics to model direct and social genetic effects for performance, behavioral and welfare traits in group-housed pigs. Specifically, we proposed: 1) Incorporate behavioral data in genomic evaluation models to estimate direct and social genetic effects of lesion score traits in pigs. 2) Examine automated methods for behavioral phenomic profiling of group-housed pigs to identify the potential for high throughput automated capture of behavior data on farm. To data on aggressive interactions between pairs of animals in the modeling of Social genetic effects for skin lesions in growing pigs we analyzed data from 792 pigs housed in 59 pens. Skin lesions in the anterior, central and caudal regions of the body were counted 24 h after pig mixing. Animals were video-recorded for 9 h post mixing and trained observers recorded the type and duration of aggressive interactions between pairs of animals. The number of seconds that pairs of pigs spent engaged in reciprocal fights were used to parametrize the intensity of social interactions (ISI). Three types of models were fitted: direct genetic additive model (DGE), traditional social genetic effect model (TSGE)

assuming uniform interactions between dyads, and an intensity-based social genetic effect model (ISGE) that used ISI to parameterize SGE. All models included fixed effects of sex, replicate, lesion scorer, weight at mixing, pre-mixing lesion count and the total time that the animal spent engaged in reciprocal fights as a covariate; a random effect of pen; and a random direct genetic effect. The ISGE models recovered more direct genetic variance than DGE and TSGE, and the estimated heritabilities were highest for all traits ($P < 0.01$) for the ISGE with ISI parametrized with unilateral attack behavior. The TSGE produced estimates that did not differ significantly from DGE ($P > 0.5$). For the automatic detection of aggression, we performed a literature review of existing tracking and behavior detection programs and selected four programs for on-farm testing. For the test we used three one-minute long video segments of a grow finishing pen at MSU's Swine Teaching and Research Center. None of the tested programs was able to maintain the identity of the tracked pigs for the length of the video segments. Thus, we proceeded to train our own algorithm for detection of aggression in pigs. We recorded 24 hours of video in a pen housing eight crossbred pigs and collected at random1666 3-second long video segments that had been manually labeled by trained experts as aggressive ($N=833$) or non-aggressive ($N=833$). Frame-to-frame distance was set and then a frame difference method was used to obtain moving pixels. Moving pixels caused by non-aggressive behaviors were removed by setting threshold of connected areas. Number of filtered moving pixels were summed and defined as motion shape index (MSI) in each frame and the maximum, mean, variance and standard deviation of MSI in each 3-secong unit were extracted as features. Finally, support vector machine (SVM) was used to classify these features in order to detect aggression. Using the proposed algorithm, aggressive behaviors could be detected with an accuracy of 97.5%, a sensitivity of 98.2%, specificity of 96.7% and precision of 96.8%. The results indicate that this algorithm can be used to detect aggressive behaviors of pigs.