RESEARCH ABSTRACT

ANIMAL SCIENCE

Title: Advancing Investigations in Swine Reproduction Efficiency at Iowa State: Part 3 - **#17-213 IPPA**

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Scientific Abstracts:

The following abstracts summarize the body of work completed with the support of this funding:

Abstract published with respect to Objective 1 (*Determining contribution of lipopolysaccharide to infertility caused by infection or heat stress in swine)*:

Heat stress (HS) negatively affects both human and farm-animal health and undermines efficiency in a variety of economically important agricultural variables, including reproduction. Heat stress impairs the intestinal barrier, allowing for translocation of the resident microflora and endotoxins, such as lipopolysaccharide (LPS), from the gastrointestinal lumen into systemic circulation. While much is known about the cellular function of heat shock proteins (HSP) in most tissues, the *in vivo* ovarian HSP response to stressful stimuli remains ill-defined. The purpose of this study was to compare the effects of HS or LPS on ovarian HSP expression in pigs. We hypothesized that ovarian HSP are responsive to both HS and LPS. Altrenogest (15 mg/d) was administered *per os* for estrus synchronization (14 d) prior to treatment and three animal paradigms were used: 1) gilts were exposed to cyclical HS (31 ± 1.4°C) or thermoneutral (TN; 20 ± 0.5°C) conditions immediately following altrenogest withdrawal for 5 d during follicular development; 2) gilts were subjected to repeated (4x/d) saline (CON) or LPS (0.1 µg/kg BW) i.v. infusion immediately following altrenogest withdrawal for 5 d; and 3) gilts were subjected to TN (20 ± 1°C) or cyclical HS (31 to 35°C) conditions 2 d post estrus (dpe) until 12 dpe during the luteal phase. While no differences were detected for transcript abundances of the assessed ovarian HSP, the protein abundance of specific HSP were influenced by stressors during the follicular and luteal phases. Heat stress during the follicular phase tended ($P < 0.1$) to increase ovarian protein abundance of HSP90AA1 and HSPA1A, and increased ($P \leq 0.05$) HSF1, HSPD1, and HSPB1 compared to TN controls; while HS decreased HSP90AB1 ($P = 0.01$). Exposure to LPS increased ($P < 0.05$) HSP90AA1 and HSPA1A and tended ($P < 0.1$) to increase HSF1 and HSPB1 compared to CON gilts, while HSP90AB1 and HSPD1 were not affected by LPS. Heat stress during the luteal phase increased ($P < 0.05$) abundance of HSPB1 in corpora lutea (CL), decreased ($P < 0.05$) CL HSP90AB1, but did not impact HSF1, HSPD1, HSP90AA1 or HSPA1A abundance. Thus, these data support that HS and LPS similarly regulate expression of specific ovarian HSP, which suggests that HS effects on the ovary are in part mediated by LPS.

Abstract published with respect to Objective 2 (*Seasonal infertility mitigation strategies. In this project we are investigating how the proteome of the uterine secretory products are altered in response to HS experienced during early pregnancy establishment*):

Heat stress (HS), resulting from environment-induced hyperthermia, compromises fertility through multiple mechanisms including communication disruption at the conceptus-endometrial interface. Study objectives were to assess HS effects on conceptus-endometrial communication by evaluating the uterine fluid composition during the peri-implantation period. Cyclic or bred gilts exposed to HS or thermal neutral (TN) conditions were euthanized during the peri-implantation period and uterine flush fluid (UFF) was collected for evaluation by relative quantification of protein content, using LC-MS/MS. For the first comparison, cyclic and bred gilts were exposed to diurnal HS (31 to 35°C) or TN (21 ± 1°C) conditions from d 3 to 12 post-estrus (n = 6 - 7 gilts/treatment). A total of 400 proteins were identified, of which 199 differed ($P \leq 0.05$) due to pregnancy status and/or thermal treatment. Pathway analysis revealed that a majority of differentially abundant proteins were chaperone proteins (HSPB-1, HSPA8, 1433B) or endopeptidases (TIMP1, MMP2) involved in growth and metabolic pathways. For the second comparison, bred animals from each thermal treatment group were supplemented with altrenogest (ALT; 15 mg/d; a progesterone receptor agonist) and were compared to bred animals not given ALT (n = 6 - 7 gilts/treatment). A total of 332 proteins were identified, of which 196 differed ($P \leq 0.05$) due to the effect of ALT and/or thermal treatment. Pathway analysis revealed proteins differentially regulated were metalloproteases (MMP2, ADAMTS1) and protease inhibitors (UFAP2, SERPINA11) involved in binding and catalytic activity. Protein expression was influenced (up- or down-regulated) more by pregnancy status or ALT than thermal treatments in the respective comparison groups. These results support the involvement of dynamic processes governing conceptus and endometrial remodeling during pregnancy establishment and demonstrate an intra-uterine profile associated with the HS response.