

# THE EFFECTS OF ELEVATED TEMPERATURE ON PREIMPLANTATION-STAGE PORCINE EMBRYOS

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## ABSTRACT

It was the objective of these experiments to more fully characterize the biochemical and developmental responses of *in vitro*-produced preimplantation stage porcine embryos to elevated temperatures. *In vitro* fertilized (IVF) and parthenogenetically activated (PA) embryos were exposed to elevated temperatures (42 C) for nine hours during the late one-cell stage of development. The IVF embryos demonstrated significant susceptibility to the applied heat stress, both in their developmental status (20.6% and 8.8% of embryos developed to blastocysts in the heat stressed [HS] and non-heat stressed [NHS] groups respectively;  $P < 0.05$ ) and their apoptotic response (26.7% of NHS embryos, and 45.6% of HS embryos with at least one apoptotic blastomere;  $P < 0.05$ ). The PA embryos were resistant to the effects of elevated temperature as applied in these experiments ( $P > 0.1$  for NHS versus HS embryos for development to blastocyst and apoptosis rates). When exposed to different timing variations of this same heat stress, PA embryos that were heat treated immediately after oocyte activation demonstrated a much

accelerated first cell cycle (63% of HS embryos cleaved by 24 hours-post-activation [hpa], as compared to 23.5% of control embryos;  $P < 0.0001$ ), and significantly higher blastocyst rates (38.0% and 18.5% for HS and NHS embryos, respectively, for example;  $P < 0.005$ ) as compared to control embryos and embryos heat treated at later timepoints. The obvious developmental differences detected in PA embryos heat treated as described were not associated with any apparent aberrations in the timing of Maturation Promoting Factor (MPF) inactivation. Mitogen-Activated Protein Kinase (MAPK) inactivation, however, occurred much earlier in heat stressed embryos (between 3 and 6 hpa) than in control embryos (between 6 and 9 hpa). Artificial maintenance of high levels of MAPK activity served to abolish the developmental discrepancies between HS and NHS embryos. Thus, the enhanced developmental potential of HS PA embryos appears to be correlated to precocious inactivation of MAPK. A more complete understanding of this phenomenon may lead to techniques that can ultimately improve the efficiency with which porcine embryos are produced *in vitro*.