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PHYSIOLOGY AND ENDOCRINOLOGY SYMPOSIUM: The current status of heat shock in early embryonic survival and reproductive efficiency[1,2]

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The Physiology and Endocrinology Symposium titled "The Current Status of Heat Shock in Early Embryonic Survival and Reproductive Efficiency" was held at the Joint Annual Meeting in Phoenix, AZ, July 15 to 19, 2012. In recent years, data has accumulated indicating a role for heat shock proteins (**HSP**) in early embryonic development and reproductive efficiency. An understanding of how these proteins influence reproductive efficiency both in vivo and in vitro could have major ramifications for production agriculture. In cattle, performance differences have been identified in *Bos indicus* breeds and genetic polymorphisms in HSP70 have been associated with reproductive performance (Rosenkrans et al., 2010). In Holstein cows, differences in expression of genes in the HSP40 family have been associated with improved early embryonic development in vitro, indicating that these proteins may have a greater role in reproductive efficiency than thought, even in animals not adapted to a tropical environment and not placed in a heat stress situation (Zhang et al., 2011). The speakers at this Physiology and Endocrinology Symposium were identified to address these topics based on their research.

High thermal temperatures can negatively impact fertility in cattle, and there is evidence that the oocyte and embryo are targets of heat stress (Hansen and Sakatani, 2012). Breed differences between *Bos indicus* and *Bos taurus* cattle contribute to heat tolerance and improved fertility under heat stress conditions (Paula-Lopes et al., 2013). Heat can induce cellular damage in both the cytoplasm and the nucleus of the oocyte. Differences in gene expression and (or) function of mechanisms that control cellular stress contribute to the ability of oocytes and embryos of *Bos indicus* origin to tolerate the stresses associated with high thermal temperatures.

Mammalian cells, including the oocyte, have developed systems to protect themselves from these stresses. Heat shock proteins, which are produced to counteract damages from external stimuli, are one such system. Driver and Khatib (2013) reviewed differences in expression of genes in the HSP family during early embryonic development related to early embryonic survival. They further reviewed associations between polymorphisms in HSP and fertility in cattle. For example, Rosenkrans et al. (2010) reported the influence of a polymorphism in HSP70 on calving percentage and calving date in Brahman-influenced cows. In their symposium presentation, Rosenkrans et al. (2012) reported a greater minor allele frequency for the G117A

[1]A symposium held at the Joint Annual Meeting, July 15 to 19, 2012, Phoenix, AZ, with publication sponsored by the *Journal of Animal Science* and the American Society of Animal Science.

[2]Names are necessary to report factually on available data; however, the USDA neither guarantees nor warrants the standard of the product, and the use of names by the USDA implies no approval of the product to the exclusion of others that may also be suitable.

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polymorphism of HSP70 in Brahman cows than in Angus cows or crossbred cows. There was a genotype-by-forage system interaction, such that cows carrying the G117A polymorphism and grazing endophyte-infected tall fescue had lower lifetime calving rates. Taken together, these data provide strong evidence for a contribution of HSP to breed differences in thermal tolerance between *Bos indicu*s and *Bos taurus* cattle.

Because a large portion of the world's agricultural lands fall within tropical and subtropical regions, it will be important to continue to understand how thermal tolerance contributes to fertility in both *Bos indicus* and *Bos taurus* cattle. Issues with age at puberty and age at first calving in *Bos indicus* cattle dictate the need for crossbreeding with *Bos taurus* germplasm to improve reproductive efficiency. Only by combining the best of both germplasms will we be able to produce the food necessary to feed an ever-increasing world population.

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