The symposium, “Participation of adult tissue-restricted stem cells in livestock growth and development,” was convened during the Joint Annual Meeting, July 15 to 19, 2012, in Phoenix, AZ. The purpose of the symposium was to raise awareness of and discuss current research efforts in the basic biology of adult stem cells in domestic animals. Five leading scientists presented efforts, as discussed subsequently, toward the isolation, characterization, and function of stem cells from multiple tissues of importance to the livestock industry.

Skeletal muscle growth in meat-producing livestock is reliant partially on the activities of muscle satellite cells, the resident stem cell population in skeletal muscle. Ronald Allen (University of Arizona), a Fellow of the American Society of Animal Science and pioneer in the field of satellite cell biology, provided insight into the movement of myogenic cells within the tissue (Allen and Liu, 2012). Rat satellite cells migrate toward the chemokine, stromal cell-derived factor 1, both in vitro and in vivo. Allen presented the results of elegant experiments injecting primary satellite cell isolates into the blood and tissues of rats and monitoring their migration and incorporation into skeletal muscles undergoing damage repair. These efforts support the position that muscle stem cells represent a motile population that can traverse the muscle bed to regions experiencing growth or repair.

Adult stem cells represent a very small fraction of the total population within a given organ or tissue. Widespread use of these cells in a translational setting within animal agriculture requires prior in vitro expansion to obtain meaningful numbers. Jon Oatley (Washington State University), an authority in male germline stem cell biology, presented innovative data highlighting the requirements for bovine spermatogonial stem cell propagation in vitro. Culture conditions that incorporate glial cell-derived neurotrophic factor, fibroblast growth factor 2, and other growth factors support expansion of the male stem cells in the absence of serum (Oatley, 2012). These results provide a foundation for future work correcting male infertility and propagation of superior genetics in livestock.

The horse has been the recipient of putative stem cell cytotherapeutics for several years. Equine athletes that experience tendon lesions are injected with autologous bone marrow- or adipose-derived stem cells. The isolates represent a heterogeneous mix of both stem cells and progenitor cells with variable engraftment potential. Sarah Reed (University of Connecticut), an equine scientist with expertise in regenerative medicine models, presented results demonstrating the extent of heterogeneity within umbilical cord blood-derived mesenchymal stem cells isolated from newborn foals. One of the more intriguing findings was the presence of a minor population containing a genetic profile similar to embryonic stem cells (Reed and Leahy, 2013).

Liver exhibits a remarkable capacity for regeneration. It also is one of the most metabolically active organs in the animal body. To better understand liver biology, Tom Caperna and colleagues at the USDA-ARS Beltsville Agricultural Research Center created a novel stem cell line capable of forming both hepatocytes and bile duct cells (Talbot et al., 2013). The bi-potential progenitor cell line represents a valuable tool for dissecting liver cell fate decisions and the impact of metabolites and growth factors on organ cell biology.
The bovine mammary gland requires a stem cell population to support the enormous turnover of epithelial cells throughout lactation. Anthony Capuco (USDA-ARS Beltsville Agricultural Research Center), a recognized expert in mammary epithelial stem cell biology, provided new information regarding the molecular identity of these elusive cells. Coupling of thymidine analog tracer kinetics with state-of-the-art cell and molecular technologies, biomarkers unique to the mammary stem cell population were identified (Capuco et al., 2012). The discovery of marker proteins will assist with future isolation and purification efforts as well as allow for in vivo cell tracking experiments throughout mammary growth, development, and the lactation cycle.

The importance of adult stem cells to the normal growth and function of livestock tissues continues to be an area of intense study. The symposium served as a forum highlighting common features of stem and progenitor cells independent of specie and location in the body and offering insight into future efforts directing stem cell fate and translational application.

LITERATURE CITED


