ABSTRACTS
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SYMPOSIA AND ORAL SESSIONS

Triennial Reproduction Symposium: Symposium I — The Follicle and Oocyte

1 The dominant ovarian follicle. M. C. Lucy*, *University of Missouri*, *Columbia*.

The dominant ovarian follicle (DF) occupies a central role in reproductive biology. Essential functions of the DF are to nurture and ultimately release the oocyte and to synthesize hormones that control reproduction. The very fact that the DF does not undergo atresia makes it unique among ovarian follicles. Considerable effort has been placed on the study of DF recruitment (the development of a follicular cohort from which the DF is selected) and selection (continued growth of the DF and regression of the remaining members of the cohort). Recruitment and selection may yield a single DF (e.g., cattle and horses), a small number of co-dominant follicles (sheep) or a large number of follicles that could be viewed as non-dominant (swine). The mechanisms through which dominance is established or not established (co-dominant and non-dominant scenarios) are of interest from a purely scientific perspective but also are important to applied reproduction. For example, overcoming dominance is the basis for superovulation and failed dominance is the basis for multiple ovulations in otherwise mono-ovulatory species (often viewed as undesirable). In most animals, the DF is short-lived; existing long enough to allow for the final maturation of the oocyte. An exception to this rule is found for cattle that develop at least one non-ovulatory DF during the estrous cycle. The end of dominance is triggered by the LH surge; an event initiated by the mature DF. The LH surge redirects the DF toward its ultimate demise (luteinization, ovulation, and differentiation into the corpus luteum). Maturation of the DF and initiation of the LH surge, which are eloquently timed in the natural setting, have proved cumbersome to manage pharmacologically. Treatments that are designed to extend the period of dominance, induce luteal regression and (or) cause ovulation may fail because the DF does not intrinsically control its developmental program. The metabolic status of an animal impinges on the DF as well and this relationship links nutrition and reproduction together. Future work on the DF will clarify the mechanisms that control DF growth and development in farm animals.

Key Words: Ovary, Dominant follicle

2 Oocyte cytoplasmic maturation: A key mediator of both oocyte and embryo developmental competence. A. Watson*[1,2], [1]*The University of Western Ontario*, *London, Ontario, Canada*, [2]*Children's Health Research Institute*, *London, Ontario, Canada*.

Efforts have intensified to successfully mature, and inseminate oocytes in vitro and then culture ensuing embryos to transferable stages from a large number of mammalian species. Success varies but generally even for the most successful species it is only possible to obtain a maximum of a 40-50% development of zygotes to the blastocyst stage. Reduced oocyte developmental competence is suggested as a primary reason for the reduced potential of in vitro produced embryos. The vast majority of in vitro matured oocytes are meiotically competent however many do not attain an optimal oocyte diameter before insemination. Variations in oocyte in vitro maturation media can influence embryo development, blastocyst cell number and apoptosis. In addition studies have indicated that cytoplasmic donation from so-called competent to incompetent oocytes can improve developmental outcomes. Oocyte cytoplasmic maturation includes those events that instill upon the oocyte a capacity to complete nuclear maturation, insemination, early embryogenesis and thus provide a foundation for implantation, initiation of pregnancy and normal fetal development. Although we can define oocyte cytoplasmic maturation we are only now beginning to understand the molecular steps that underlie this process. In general terms oocyte cytoplasmic maturation involves the accumulation of mRNAs, proteins, substrates and nutrients that are required to achieve the oocyte developmental competence that fosters embryonic developmental competence. Both immediate and longer term effects of oocyte cytoplasmic maturation will be discussed including influences on cumulus cell-oocyte communication, cumulus cell expansion, insemination and oogenetic control of zygote development to the blastocyst stage. Collectively we are beginning to specify oocyte cytoplasmic maturation and eventually a coherent understanding of this critical event in oocyte biology will emerge.

Key Words: Oocyte, Embryo, In vitro maturation

3 Regulation of oocyte meiotic maturation. F. J. Richard*, *Université Laval*, *Québec, QC, Canada*.

Mammalian oocytes are arrested at prophase of the first meiotic division before induction of maturation by the preovulatory luteinizing hormone surge. In vitro, oocyte maturation occurs spontaneously. The first meiotic arrest is characterized by a large nucleus called the germinal vesicle. One important signalling molecule for resumption of meiosis is cAMP. High levels of cAMP block spontaneous meiotic resumption. Research investigating the regulation of oocyte cAMP has led to the discovery of new receptors, G proteins, cyclases and phosphodiesterases. Leydig insulin-like 3 (INSL3), a polypeptide growth factor of the insulin family, is expressed in theca cells. INSL3 activates LGR-8 (leucine-rich repeat-containing G protein-coupled receptor 8) which is expressed in the oocyte. LGR-8 is coupled to the inhibitory G protein, thus leading to a decrease in cAMP production. Treatment with INSL3 initiates meiotic progression of oocytes in preovulatory follicles, demonstrating the importance of cAMP management for meiotic resumption. Furthermore, microinjection of an anti-Gs protein into mouse oocytes resulted in meiotic resumption, suggesting that meiotic arrest of the oocyte was dependent on Gs activity. The orphan Gs-linked receptor GPR3 is expressed in the oocyte. The oocytes of null-GPR3 mice resume meiosis when still in their follicles, suggesting that GPR3 is involved in the control of cAMP production, and thus meiotic maturation. Cyclic nucleotides are synthesized by cyclases and degraded by phosphodiesterases. Mouse and rat oocytes express isoform 3 of adenylyl cyclase. In the mouse, the null mutation results in approximately 50% of the oocytes resuming meiosis, demonstrating the importance of the synthesis of cAMP in controlling nuclear maturation. The null mutation of the major PDE expressed in mouse oocytes (PDE3A) results in female sterility due to ovulation of GV-arrested oocytes that cannot be fertilized. Maintenance of meiotic arrest is explained by constitutive cAMP signalling associated with undetectable cAMP-PDE activity. Collectively, these results are starting to illuminate the key players involved in the control of oocyte cAMP and thus, nuclear maturation.

Key Words: Oocyte, Maturation, cAMP

Triennial Reproduction Symposium: The USDA-NRI in Reproduction — Relevance to Production Agriculture

4 The National Research Initiative (NRI) competitive grants program in animal reproduction: Changes in priorities and scope relevant to U.S. animal agriculture. M. A. Mirando*, *Cooperative State Research, Education, and Extension Service, United States Department of Agriculture*, *Washington, DC*.

The NRI is the USDA's major competitive grants program and is administered by the Cooperative State Research, Education, and Extension Service (CSREES). The NRI was authorized by the U.S. Congress in the 1990 Farm Bill at a funding level of $500 million; however, the maximal NRI appropriation was $181.17 million in fiscal year (FY) 2006. Across all programs, the NRI is mandated to use 30% of its funding to support mission-linked research. Since its inception in 1991, the NRI has funded competitive grants in the discipline of animal reproduction. Before 2004, the Animal Reproduction Program funded a broad range of projects encompassing almost every sub-discipline in reproductive biology of farm animals, including aquatic species important to the aquaculture industry and laboratory animals. During FY 2004, the NRI Animal Reproduction Program narrowed the focus of its funding priorities to five issue-based topics in an effort to make greater measurable improvements in a few high impact areas over the next 10 years. Funding priorities were narrowed further in FY 2006 to three sub-disciplines based, in part, on recommendations that emerged from a stakeholder workshop conducted by CSREES in August, 2004. In FY 2003, Congress authorized expenditure of up to 20% of funds appropriated to the NRI to support projects that integrate at least two of the three functions of research, education, and extension-outreach. In FY 2004, the Animal Reproduction Program included a funding priority for integrated projects focused primarily on infertility in dairy cattle. The program funded its first integrated project in FY 2005. During FY 2002, increased emphasis on justification for use of model systems (e.g., laboratory animals and in vitro systems) was included in the NRI Request for Applications (RFA). In FY 2006, applications proposing to primarily utilize nonagricultural animal models were excluded from the program. Currently, all proposed studies must be thoroughly justified in terms of relevance to U.S. animal agriculture and relevance to program priorities identified within the RFA.

Key Words: Reproduction, Grants, Funding

5 A researcher's perceptions of USDA funding in reproduction. J. J. Reeves*, *Washington State University*, *Pullman*.

Through the 1970's, NIH was the only source of federal competitive research funding for Animal Scientists in reproduction. This required couching domestic animals as models for basic research on human reproduction. The first USDA Competitive Research Grants Program was initiated in 1978 under the auspices of the Competitive Research Grants Office. Again, Animal Scientists could only get funds for research in reproduction through the Animal Health Special Grants Program, which began in 1980. Dedicated funding for animal reproduction did not start until 1985 and was available primarily in the reproductive efficiency and physiology areas of the Animal Science Program. Funding for individual grants and duration of funding were similar between NIH and USDA, typically in the range of 3 years with total direct costs of $150,000. USDA funding in reproduction permitted directing research more toward the animal industry and less toward human reproductive problems or animal health problems. The names of these programs have changed over time, the National Research Initiative (NRI) Competitive Grants Program started in 1991 with a program in Animal Reproduction. Successful funding of individual grants has been based on an industry problem with a sound hypothesis and basic technology. The USDA review system has been based on external (ad hoc) reviewers as well as a primary and a secondary panelist reviewer. This review system may drop the external reviewers. USDA did not change the award size for individual grants until 2001 when it gradually increased through 2003. It then markedly increased individual grants in 2004 to a funding level of $300,000-$500,000 over 3 to 4 years. This is good in some respects but results in funding many fewer grants. Policies based on funding the best designed and presented proposals in priority areas should continue. The number of grants funded per year is approaching a low critical number, with an average of only 10 new grants funded per year. At the present funding level it will be difficult for even the best scientist to sustain a research career based only on USDA funding.

Key Words: USDA, Grants, Reproduction