Application of nanotechnology in assisted reproduction in farm animals

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The rapid development of nanotechnology has led to the production of fluorescent and magnetite nanoparticles with promising applications in biology. Various nanoparticles have been used for disease diagnoses or therapies, and the ability to combine them with various bio-molecules offers new possibilities to elucidate biological processes that trigger a given physiological status of a cell or an organism. Our laboratory is pioneering a new study that aims at employing such nanoparticles for non-invasive bio-imaging in animal reproduction. We used self-illuminating quantum dot nanoparticles (QD) that were conjugated to a light emitting protein luciferase (QD-BRET) to allow both fluorescence and bioluminescence imaging of cells. These QD-BRET were used for targeted and non-targeted imaging of living mammalian spermatozoa and *in vitro* cultured ovarian follicles. The QD-BRET successfully interacted with cells and neither the fertilizing potential of spermatozoa nor the development of ovarian follicles were affected by the labeling. Preliminary data indicated that the toxicity of nanoparticles could be avoided when used in appropriate ratios to balance with sperm cells. Additionally, the photo-stability and brightness of the QD-BRET fluorescence make them an excellent tool for *ex vivo* imaging of growing ovarian follicles and spermatozoa within the reproductive tract. Furthermore, we successfully bio-functionalized magnetite nanoparticles with high affinity proteins to allow specific purification of semen that enhances fertility of males and generate a gender selection of offspring. The prospect of applying nanotechnology in the area of reproductive biology is promising and further studies are needed for better optimizations. Funded by the USDA-ARS grant# 58-6402-3-0120.