Biotechnology: Status and Uses

Animal Science 434
John J. Parrish

Reproductive Biotechnology's
- Artificial insemination
- In vitro embryo production
- In vivo embryo production
- Embryo transfer
- Gender selection
- Stem Cells
- Genetic engineering
- Cloning

In Vitro Production of Embryos
- Oocyte isolation and maturation
- Sperm preparation
- Sperm capacitation
- Fertilization
- Embryo Development

In Vivo Embryo Production
- Normal cycling female
  - horses
- Superovulated female
  - Cattle
  - Sheep
  - Goats
  - Deer
  - Humans

Stimulating Follicular Development

Non-Surgical Embryo Flush
Day 6 or 7

Stimulating Follicular Development
- Estrus
- eCG or FSH
- PGF2α
- Multiple Ovulations
- Progesterone From C.L.

Non-Surgical Embryo Flush
Day 6 or 7
Stage of Embryo at Recovery

- Tight Morula (day 5 - 7)
- Early Blastocyst (day 7 - 8)
- Blastocyst (day 7 - 9)

Embryo Sexing

- Hy Antigen
  - Associated with male cells
- PCR and Detection of Y and X DNA

Hy-Antigen

Octopus Springs - Yellowstone National Park

Home of *Thermus aquaticus* - Taq Polymerase

PCR Approach to Embryo Sexing
Sperm Gender Selection

Selection of X or Y sperm

PERCENT DNA DIFFERENCES BETWEEN X and Y CHROMOSOME

- Human: 2.9
- Cattle: 3.8
- Chinchilla: 7.5
- Turkey: 0

X Chromosome has more DNA!!

Sperm Gender Selection

- Flow Cytometry
  - Only method that works!
  - Very few sperm recovered
  - Reduced fertility
  - Expense will limit use

Fetal Sexing

- Ultrasound Evaluation
  - Day 55 - 65

Cloning

Split morula
Cloning by Nuclear Transfer

Cycles are limited
Only 3 - 4 cycles

Nuclear Cloning to Produce Stem Cells
- Cells of interest grown in culture dish
- Mature oocyte enucleated and cell of interest fused
- Embryo?? Develops
- Potential tissue:
  - Neural
  - Adipose
  - Connective
  - Heart
- Inner cell mass cells isolated and grown in culture

Stem Cells Grown in Culture and Allowed to Differentiate

Benefits of Stem Cell Research
1. Regenerative medicine and tissue engineering
   - In vitro systems: drug discovery, toxicology, diagnostic assays and cell culture reagents
   - Biomedical research: unravel mechanisms of disease and human development

Genetic Manipulation

Transgenic for Growth Hormone
Gene Transfer Using Micro-Injection of Pronuclei

Less than 1% efficiency

Gene Transfer Using Viral Transfection

Better success but left with potential for viral replication