Benefits of OPU/IVF (IVP) in Dairy Cattle

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Expectations

- What is OPU/IVF (IVP)?
- ARTs used at ST Genetics
- Donor Selection
- Donors
- Animal Welfare
- Care of Juvenile Donors
- Equipment
- Environment Conditions
- OPU Technique
- Effect of age on IVP
- Benefits vs Challenges of IVP
- Advantages of SexedUltra 4M™ in IVP
Introduction

- ST Vienna Farms

- Donor center with 300 heifers

- *In Vitro* and *In vivo* embryo production

- Genomic animals

- Holstein (Red and BW), Jersey, Brown Swiss
What is OPU/IVF (IVP)?

- *In vitro* production of ruminant embryos is a three-step process involving oocyte maturation, oocyte fertilization and in vitro culture. Only 30-40% of such oocytes reach the blastocyst stage, at which they can be transferred to a recipient or frozen for future use (*Lonergan*, 2007).

- Ultrasound-guided transvaginal follicular aspiration for ovum pick-up (OPU), is a non-invasive procedure for recovering oocytes from antral follicles in live animals. Together with in vitro fertilization of oocytes, OPU has been taken as a most flexible and repeatable technique to produce embryos from any given live donor (*Qi et al*, 2013).
ARTs used at STgenetics

• IVP (in vitro embryo production) 70% of our Donors
• MOET (multiple ovulation embryo transfer) 30 % of our Donors
• AI (artificial insemination) 100% of our donors
Donor Selection

• Genetic Value
• Health status
• Breed (*Bos Taurus* vs *Bos Indicus*)
• Body condition score (BCS); Nutritional Status
• Reproductive evaluation (Ovaries, Follicular Population, etc)
• Reproductive status (Open, Pregnant)
• Age (Pre-Pubertal, Pubertal, Mature)
• Cow production status (Milking, or Dry)
Donors

DELTA DAUGHTERS
Animal Welfare
Care of Juvenile Donors
Equipment

• Vacuum Pump (negative pressure)
• Tube Warmer (temperature)
• Ultrasound Machine (with micro convex probe)
• Guide for Ovum Pick up
• Tubing line, silicone cork, 50 ml tube
• Needles for OPU
Environment Conditions
**OPU Technique**

1. Epidural prior to the procedure/Animal restrained
2. Positioning of the ovary per rectum
3. Visualization of follicles by the transducer
4. Ovum pick up by needle
5. Search and evaluation of oocytes
Ovum Pick Up (OPU)
In Vitro Production

Photos by Daniela Pereira
Effect of Age on IVP

Chart 1 - 578 OPUs, 381 Donors, 75 bulls, 8277 Oocytes, 2604 Embryos
Effect of Age on IVP

Chart 2 - 578 OPUs, 381 Donors, 75 bulls, 8277 Oocytes, 2604 Embryos
Effect of Age on IVP

Chart 3 - 578 OPUs, 381 Donors, 75 bulls, 8277 Oocytes, 2604 Embryos
Effect of Age on Fertility

P = 0.006
N = 11852
Effect of Age on Fertility

Probability of Pregnancy Loss D33-60

Donor Age (months)

P=0.002
N=5147
Benefits vs Challenges of (IVP)

Benefits

- Non invasive technique
- Use of hormones or not
- Donors can be aspirated very often
- Animals can be aspirated at any time and stage (juvenile and pregnant)
- Can freeze or vitrify embryos
- Possibility to use Sexed Semen (SexedUltra 4M™)
- Low cost of semen (cost effective)
- More pregnancies per year than ET, and AI

Challenges

- Laboratory and skilled personal is needed
- Pregnancy loss is slightly higher than ET and AI
- Overall cost is High
- Challenge to export to some countries
Advantages of SexedUltra 4M™ in IVP

• Genetic improvement
• Gender selection with SexedUltra 4M™
• More replacements - of the right heifers
• Increase in milk production, increased net merit (NM$’s), Fat, and Protein
• Additional income source with extra heifers
• Heifers calving easy
• Great conception rates on AI with SexedUltra 4M™
• #1 benefit to Sexed Ultra 4M - increased conception rate, close to and / or beat conventionally conception rate
Advantages of SexedUltra™4M in IVP

Use of Sex Semen on IVF

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<th>Embryos</th>
<th>Oocytes</th>
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<tr>
<td>Conv semen</td>
<td>5.4</td>
<td>15.3</td>
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<tr>
<td>Sexed semen</td>
<td>4.2</td>
<td>14.0</td>
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Chart 4 - Sexed semen Female/Male: 909 OPUs, 408 Donors, 67 Bulls, 3846 Embryos
Conv Semen:  537 OPUs, 276 Donors, 99 Bulls, 2915 Embryos
Advantages of SexedUltra 4M™ ST Partner Herds

122,876 Insemination
Recipient Selection

• Age, Health Status, Breed, DPR

• Body condition score (BCS); Nutritional Status

• Reproductive evaluation (Ovaries, Reproductive tract, etc.)

• Use of CIDR sync/natural heat
Conception Rate According to Body Score

Chart 6 - Conception rate at 32 and 60 days according to body condition score (n=1,919) in dairy heifers submitted to embryo transfer.
Chart 5 - Conception rate at 32 and 60 days and according to daughter pregnancy rate (DPR - n=1,509) in dairy heifers submitted to embryo transfer.
Conception Rate According to the Size of Corpus luteum

Chart 7 - Conception rate at 32 and 60 days according to the size of Corpus luteum on day 5 of estrous cycle in dairy heifers submitted to embryo transfer.
Conception Rate per Number of Breeding

Chart 8 - Conception rate at 32 and 60 days according to number of breeding (IVF, n=2,027) in dairy heifers submitted to embryo transfer.
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<tr>
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<th>Conception rate d32</th>
<th>Conception rate d60</th>
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<tbody>
<tr>
<td>Heat Synchronization</td>
<td>48.8%</td>
<td>49.5%</td>
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<tr>
<td>Return to Heat</td>
<td>42.1%</td>
<td>41.1%</td>
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Chart 9 - Conception rate at 32 and 60 days according to type of heat (n=2,015) in dairy heifers submitted to embryo transfer.
Conception Rate Crossbreed Angus/Holstein vs. Holstein

Chart 10 - Conception rate at 32 and 60 days in Crossbreed Angus/Holstein vs. Holstein.
Chart 11 - Percentage of CL and conception rate at 32 days according to the CL side on ovary (IVF, n=10,343) in dairy heifers submitted to embryo transfer.
Conclusion

• ARTs enabled ST to expedite genetic improvement
• Production of elite animals to improve genetics in the whole cattle industry
• Expedite the production of embryos from valuable donors and bulls
• Decrease the interval between generations
• Focus on the use of male semen in order to produce bulls
• Challenge sexed semen in young genomic donors