THE USE OF GENDER-SELECTED SEMEN IN DAIRY PRODUCTION SCHEMES

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TAKE HOME MESSAGES

- The use of gender-selected (sexed) semen is a useful tool for the production of calves of pre-determined sex.

- The use of in vitro fertilization with sex-selected semen and the large-scale transfer of in vitro-produced (IVP) Holstein heifer embryos into beef recipients is a feasible production scheme.

INTRODUCTION

For thousands of years, livestock owners have desired a methodology to predetermine the sex of offspring for their herds. For dairy cattle, this means heifer calves. A 2005 market report (Lancaster County, PA) according to Livestock Reporter Network listed 90-120 lb. Number 1 Holstein heifer calves selling for $510-590, whereas 90-120 lb. Number 1 Holstein bull calves sold for $170-208. Considering the need for replacement heifers in their own herds, as well as the nearly 3-fold increase in monetary value for heifer calves over bull calves, it is no wonder than modern dairy producers are interested in options that allow them to predetermine the sex of their calves.

The ability to sort individual sperm cells into viable X- and Y-chromosome-bearing fractions made producer’s sex selection dream a reality in the 1990’s. Semen can be sexed with greater than 90% accuracy with use of a flow cytometer cell sorter, although, there have been slight differences in the sexing accuracy shown between the X-sorted sperm (87.8%) and Y-sorted sperm (92.1%) in calves born. The economics, applications and issues surrounding commercialization of the sexed-semen technology have also been recently reported.

There have been a number of recent reviews on the topic of the use of sexed semen in cattle production as well as studies that have evaluated the use of sex selected semen for artificial insemination (AI) and in vitro embryo production (IVP). A major concern with the implementation of sexed-semen technology is that the fertility of sorted sperm is somewhat lower than that of control, unsorted sperm. However, most of the early studies concerning the fertility of sexed-semen were confounded by the insemination of animals with fewer sperm per dose than with normal unsorted control sperm. When numbers of sorted sperm per dose were equivalent to those used with conventional AI, pregnancy rates for the sexed sperm have been on the order of 60-80% of those found with unsorted control sperm.

Another concern is that the survival of sorted sperm after cryopreservation is also decreased. After a series of experiments to optimize the cryopreservation of sexed sperm it was concluded that the present methods used for flow cytometric sexing of sperm resulted in somewhat lower
post-thaw motility and acrosomal integrity when compared to unsorted control sperm. Further, the damage to the sperm is negligible compared to the damage caused by routine cryopreservation and that the fertilizing capability of sorted sperm is adequate based on several straightforward laboratory analyses.

One of the early major drawbacks to implementing the extensive use of sexed semen technology was the number of sperm that could be separated in a specified time period. This situation seems to have been adequately addressed by the new generation of flow cytometers. Modification of the orienting nozzle of the flow cytometer has allowed for the increase in sorting rate from about 0.35 million sperm per hour to between 5-6 million sperm per hour of each population. This speed may be increased even more with future equipment developments. A number of companies worldwide now have licenses to produce and sell sexed semen. The primary market appears to be to individual bull owners and for AI studs.

**IVP WITH SEX SELECTED SEMEN**

One very appealing attribute of using flow-sorted sperm for IVP is that considerably fewer sperm are needed for *in vitro* fertilization (IVF). Over the past dozen years, sexed semen has been used in several studies to produce embryos *in vitro*. However, a number of issues appear to influence the success rates when sexed semen is used to produce bovine embryos *in vitro*. These issues include lower fertilization rates, lower cleavage rates, lower blastocyst rates, lower pregnancy rates, partial capacitation of the sperm, dilute sperm samples, and sire variation.

**OUR EXPERIENCE**

We have previously, evaluated a production scheme involving single and bilateral twin transfer of Holstein female embryos to beef cattle recipients. The control IVF system has been consistent for our lab, with high cell number, inner cell mass allocations similar to those observed *in vivo*, appropriate elongation stage morphology, and most importantly, acceptable pregnancy rates and low birth weights of resulting calves. We were interested in examining pregnancy and calving rates of *in vitro* produced bovine embryos fertilized with sexed and non-sexed sperm. Holstein oocytes obtained from abattoir-derived ovaries were fertilized with the X-bearing fraction of gender-sorted Holstein semen. Approximately 95% of the calves were female. Transferring two embryos resulted in a higher calf yield per recipient than transferring single embryos (P<0.01), although individual embryo survival tended to be lower for those transferred as twins (P<0.1). These results demonstrate that *in vitro* fertilization with sex-selected semen and the large-scale transfer of IVP Holstein heifer embryos to beef recipients is a feasible production scheme.

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