Semen Sexing: State of the Art

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Can we indeed, predetermine the gender of farm animals through the use of sexed semen? For years, animal scientists, mothers, fathers, aunts, uncles, cousins, soothsayers, Ouija boards, barbers, and shoe salesmen have all boasted about a 50% success rate. Not bad, but cattle ranchers across America need a little more substance than that before opening up their pocket books for sexed semen.

To be accepted in the real world of cattle breeding, sexed semen should be predictable to the 90% level, provide pregnancy rates comparable to existing AI standards, and affordable. Currently, the world offers no such services to the cattle industry. However, there is some promising technology in this field that at least offers some hope for the future.

Larry Johnson, a scientist for USDA, Agriculture Research Service, Germplasm & Gamete Physiology Laboratory, has been working towards perfecting a sperm separation technique that involves DNA staining, male and female differences in DNA mass, laser technology, electromagnetic charges, and flow cytometric sorting of male and female chromosome bearing sperm.[1] There is a measurable difference between the volume of DNA in the X and Y chromosomes of male and female bearing sperm. After having been exposed to DNA specific stain, individual sperm cells are rapidly run through a cell sorting chamber and are assigned a positive or negative charge depending on the volume of DNA measured by a laser shadow. The sperm are given a positive or a negative charge based on their volume of DNA and then sorted according to their charge and placed in separate collection vessels.

The limiting factor with this technique is speed. Roughly, about 2000,000 to 300,000 sperm per hour can be sexed. For routine AI in cattle, the industry standard is about 10 million normal motile sperm per unit of semen to get optimal results. This obviously makes this process too slow for widespread commercial use. However, *in vitro* fertilization (IVF) is definitely a candidate for this flow cytometry technique as only a few thousand sperm are needed to fertilize a group of oocytes *in vitro*. Currently a New Zealand company owns the license for this process and is trying to speed up and perfect the technology with the ultimate goal of taking it commercial.

There is no doubt that the process is effective and accurate. Live offspring have been born from cattle, sheep, and swine (and maybe others by now) with results greater than 85% correct. However, at this point in time, it appears that there are too many obstacles to overcome to put this to commercial use. Where there is a will there is a way, however, and current research is underway to determine if very low numbers of total live sperm can be used to achieve acceptable pregnancy rates. Some preliminary data from George Seidel (Personal Communication) at Colorado State University looks very interesting. He reports 41% pregnancy rates on AI with virgin heifers using 100,000 total live sperm/insemination and 52% pregnancy rates with 250,000 total live sperm/insemination. The control in this project was 10 million motile sperm which yielded 63% conception.

If the rate of speed for sexing sperm could be increased from 10 to 100 times, then certainly the process would start looking more promising. At least there is finally a reference point in the industry that is scientifically valid and proven. It would be difficult and inaccurate to predict when sexed sperm will be commercially viable. As far as other scientifically valid techniques that are in progress for sexing sperm, I could not find anyone in the animal science industry that was aware of such. Maybe someone in the meeting knows of a way to position the bull at a certain phase of the moon and have the cow pointed eastbound and downhill so that the odds are definitely increased for heifer calves. My barber guarantees it!

Reference

1. Johnson, L.A., Cran, D.G. and Polge, C. (1994) Recent advances in sex preselection of cattle: flow cytometric sorting of X- & Y- chromosome bearing sperm based on DNA to produce progeny. *Theriogenology* 41:51-56.

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