



Background: Artificial insemination and the Reproductive Industry.

Industry overview: Although not an industry that many people think about on a daily basis (or even an annual basis for that matter), reproduction truly is the basis for all our food production, as well as for genetic improvement that allows our current food needs to be met with the same number of animals.

Consider, 604 pounds of dairy products are consumed by each person in the U.S. every year. All the required milk is produced by cows. Cows must be pregnant every year to give milk! There are about 9 mm cows in the U.S. This number has remained relatively constant for the past 10 years. This means that every cow produces more milk per year, an increase due to improved genetics.

In pigs, the number of piglets born to a sow has increased from 8 to 12 over 20 years. This improvement has enabled a smaller number of farmers to serve the needs of the pork industry.

Male turkeys (toms) have large breasts (to produce more 'white' meat) and therefore cannot breed naturally. To produce more birds, hens are artificially inseminated.

Artificial insemination is used in humans for a variety of reasons. Soldiers use it to store sperm in case of injury during

deployment and it assists infertile couples achieve parenthood.

Artificial insemination (or A.I.): A.I. is the process of using a vial of semen instead of a male animal to produce a pregnancy. The sperm is collected from the male. It is then diluted. The dilution step is necessary because sperm are highly concentrated and would not survive long outside the body if not diluted.

The diluted sperm cells are then cooled. At this stage it can be shipped to the female. Cooled sperm lasts a few days and is damaged by oxidants so that the longer it is held, the less likely it will produce a full term pregnancy.

Cooled sperm can, in some animals, be frozen in liquid nitrogen. Bull sperm, for example, is almost always frozen. Freezing also causes physiological damage to the sperm cells in part due to oxidation.

The cooled or frozen sperm is shipped to the female then warmed (or thawed). This stage also causes damage to the cells. The warmed sperm is injected into the female animals.

9 Million Cows
in the U.S.

70% dairy
COWS artificially
inseminated at least
2 times/pregnancy.

4-15%
growth in bovine
sperm market in
past 4 years.

9.2 million
horses in the U.S.

5.8 million
sows in the U.S.

34.8 million
doses of sperm to
inseminate sows.

90% of turkeys
are artificially
inseminated.

\$4.04 billion-
size of human
assisted
reproduction

Damaged sperm, regardless of cause, can reduce the chances of pregnancy.

Sperm is collected and packaged by 'Genetics Centers' or 'Studs'. These are businesses that own or lease male animals, collect their genetic materials (sperm) then sell it to farmers or others that own female animals.

Net effect of A.I.: Artificial insemination has profoundly and positively affected the production of dairy cows, litter size in pigs, egg size in chickens and the amount of meat per animal.

The improvements are due to improved access to genetic diversity. In days past, farmers had to use male animals they raised, or perhaps their neighbor's male animals. Now, because sperm can be held for days (cooled) or years (frozen), farmers have access to male animals anywhere in the U.S., or even in the world. This access allows farmers to target the traits they need to improve their herd or flock.

Monetary impact: Like humans, animals can only get pregnant during certain times in a given month (during ovulation). So,

- If that window of opportunity is missed,
- OR, if the sperm is damaged to such an extent that pregnancy does not occur,
- OR, if the pregnancy occurs but is lost within the first 30 days,
- OR, if the number of pregnancies per animal is decreased (in litter-bearing animals),

THEN, the farmer loses a significant amount of money!

The latter 3 of the 4 items mentioned above **are directly impacted by sperm quality used to achieve pregnancy.**

In dairy farmers, reproductive inefficiencies cost >\$300 mm because milk production decreases if pregnancy rate is not optimized. Part of this loss is because farmer has to continue to care and feed a non (or low) producing animal for another month or more until she becomes pregnant. A non-pregnant cow is only worth her weight (meat price).

In pigs, having a litter of 12 live piglets is much more profitable than having 7 or 8 piglets.

Therefore optimizing pregnancy and fertility with artificial insemination is of utmost importance to optimize the financial efficiencies of the farmer.

Addressing the problem: One of the steps that can be utilized to improve reproduction is to prevent damage to the sperm cells while they are cooled and/or frozen.

Membrane Protective Technologies technology, GameteGuard™ protects sperm during the processing necessary for artificial insemination. This protection helps to improve the odds of achieving a pregnancy and retaining that pregnancy.

