



Repro Tracks

► by **Cliff Lamb**, University of Florida

Semen and embryo handling

The 2016 spring breeding season has wrapped up, and many cattlemen will likely not be breeding again until next spring or will be preparing for fall breeding. I had the opportunity to witness many breeding projects this season. I was struck by the condition of many of the semen- and embryo-storage devices, and by how the semen was handled.

In addition, the handling of semen and embryos for transport or for thawing frequently made me realize that producers do not appear to realize the impact of poor handling on fertility. Since this issue of the Angus Journal focuses on “building your business,” I thought it would be prudent to address the impact of poor storage and handling of genetic material on a beef operation.

Handle with care

What happens when semen and embryos are frozen?

When freezing biological cells, such as semen or embryos, the main goal is to remove water from within the cells. Removal of water molecules minimizes the formation of ice that is formed when water molecules freeze at temperatures below freezing (i.e., 0° Celsius, or 32° Fahrenheit). Removal of water is important to prevent the formation of ice, which causes damage to cell membranes, organelles and chromosomes.

Therefore, cryoprotectants such as glycerol or ethylene glycol are frequently used to dehydrate cells before freezing. Once exposed to cryoprotectants, semen and embryos are cooled at a slow rate and then plunged into liquid nitrogen, which has a temperature of -196° C (-320.8° F). From this point, semen and embryos should never be exposed to temperatures greater than -130° C (-266° F) until it is time to thaw the semen or embryos.

What happens if the temperature of stored semen or embryos rises above -130° C?

This -130° C is key since it is the glass transition temperature of water. If semen or embryos are increased above this temperature, then recrystallization of cells occurs and damage to cell membranes and organelles can occur. The severity of this damage is based on how high the temperature reaches and duration that the cells are exposed to that temperature.

The neck of most liquid-nitrogen storage containers ranges from room temperature to -75° C (-103° F). It is not difficult to see that frequently lifting a canister of semen or

embryos to the neck of a storage container may cause some damage to semen or embryos. See Table 1 for temperatures at various depths in the neck of a typical liquid-nitrogen container.

I have frequently noted that someone handling semen or embryos assumes that if the straw remains frozen or solid that no harm is done. However, this simply is not the case since ice becomes unstable at temperatures above -80° C and significant damage can occur.

Table 1: Temperature in the neck of typical liquid-nitrogen storage tank

Depth in neck, in.	° Celsius	° Fahrenheit
0	24.1	75.4
-1	21.9	71.4
-2	11.9	53.4
-3	-23	-9.4
-4	-47.1	-52.8
-5	-73.6	-100.5
-6	-110.5	-166.9
-7	-160.4	-256.7
-8	-181.2	-294.2

Source: Adapted from Stroud, 2015 Applied Reproductive Strategies in Beef Cattle, Stillwater, Okla.

What are some of the considerations to be made when handling semen or embryos?

When semen or embryos are collected and frozen, they are usually frozen by a well-trained expert who uses the correct

techniques. However, once the frozen cells leave the semen company or embryo technician, there are many opportunities for handling to cause problems. Frozen gametes (semen or embryos) are frequently handled by people who do not have the necessary training, such as farm/ranch employees, artificial insemination (AI) technicians, family members, office administrators or ranch owners.

Opportunities for mishandling can occur: (1) while receiving and transferring samples from a dry shipper to a liquid-nitrogen storage container; (2) when thawing samples; (3) during inventory management; (4) when preparing samples for shipment; or (5) while transferring straws from one cane to another. Improper handling at any of these points may result in damage. In addition, repeating the mishandling events can cause cumulative damage to the cells and potentially result in totally infertile semen or embryos.

A potential consequence of these mishandling errors is the time taken to determine why poor pregnancy rates resulted. Mishandling may be a primary cause of poor pregnancy rates, yet nutrition, herd health, synchronization system or technician may be assumed before mishandling of semen is identified as a potential concern.

Does origin of the shipment have an effect on fertility?

Beef semen and embryos are transported in shipping containers frequently. Generally semen and embryos are shipped either by a bull collection facility, embryo technician or by individual producers. It is important to note that receiving semen or embryos directly from a bull collection facility or embryo technician likely will result in fewer issues with fertility than receiving these items from a producer.

Veterinarian Brad Stroud (www.stroudet.com) has reported data that demonstrate the incidence of unacceptable semen from bull studs or from producers (Table 2). Semen samples shipped directly from bull studs where it was collected, processed and stored had an unacceptable classification rate of only two per 100 batches evaluated. Conversely, semen samples hand-delivered or shipped from animal breeders had an unacceptable rate of eight per 100 batches examined. Therefore, semen that has been in

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the hands of animal breeders and other sources at some point postfreezing was four times more likely to be classified as unacceptable compared to that stored and shipped directly from a bull stud.

What are impacts of poor semen handling?

It has been estimated that poor semen

handling has resulted in a decrease in viable embryos of between 5% and 9%. This translates to approximately 125,000 to 300,000 potential pregnancies that have failed to artificial insemination every year in the United States as a result of mishandled semen. Proper handling techniques for frozen semen and embryos are easy to implement and should be as fundamental

as detecting estrus, good injection-site management, passing an AI gun through a cervix or inserting a CIDR®. Adhering to proper semen and embryo handling should reduce the negative impacts of damaged gametes to the success of the AI or embryo transfer program.



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Table 2: Impact of origin of semen on acceptability of the semen upon arrival

Origin of shipment	No. of shipments	No. classified unacceptable	% Unacceptable
Bull studs	426	9	2.1
Owners/others	314	25	8

Source: Adapted from Stroud, 2015 Applied Reproductive Strategies in Beef Cattle, Stillwater, Okla.