A REPRODUCTIVE MOMENT WITH MEL

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Pros and Cons of the Half- and Quarter-cc Straws

While European-based A.I. companies historically have marketed semen in one-quarter cubic-centimeter (¼-cc) straws, U.S. A.I. companies have provided semen in one-half cubic centimeter (½-cc) straws. One U.S. A.I. marketing organization recently began a transition to ¼-cc straws, which has encouraged producers to ask, "Why the difference?" Some of the promotional materials accompanying this transition even have suggested that the customer can expect higher conception and fertility with this "new" package size.

So, what's the true story with all this hullabaloo?

> *"Both the ½- and ¼-cc straw will have the same total number of sperm... that's what's really most important—the total number of live sperm placed in the reproductive tract, not the straw size."*

A Historical View

The true story is that the ¼-cc straw is nothing new. When ampules were replaced by the French straw back in the late '60s and early '70s, the U.S. A.I. industry, after careful evaluation of each, opted for the ½-cc straw, while A.I. organizations in Europe and later Canada chose to use the smaller diameter ¼-cc straw.

Freezing and Thawing

Because of its smaller diameter, the quarter-cc straw lends itself to slightly faster freezing rates and the potential for a slightly improved post-thaw sperm survival, provided glycerol levels and freezing rates are adjusted appropriately to accommodate the alternative packaging system. However, the characteristics of the ¼-cc straw that allow for this slightly improved post-thaw survival (large surface-to-volume ratio) also make the ¼-cc more sensitive to thermal insult during straw retrieval and/or after thawing.

An extensive, detailed comparison of the thermal sensitivity of ¼- and ½-cc straws was published in the proceedings of the sixth National Association of Animal Breeders (NAAB) technical conference in 1976. In that study[1], the effects of thermal insult during on-farm straw retrieval from the liquid nitrogen storage vessel were mimicked by exposing frozen straws to room temperature (20 degrees Celsius) for intervals of 15 seconds, 30 seconds, or one, two and four minutes before plunging back to liquid nitrogen temperatures. The temperature inside the ¼-cc straws rose much more rapidly when exposed to room temperature than did the ½-cc straw (Figure 1). And, the reduction in post-thaw sperm motility in response to these thermal insults was much more dramatic in ¼- than in ½-cc straws (Figure 2).

Figure 1. Effect of a one-time exposure to room temperature air (20 C) on internal temperatures of ¼- and ½-cc French straws (Adapted from Berndtson et al., 1976).

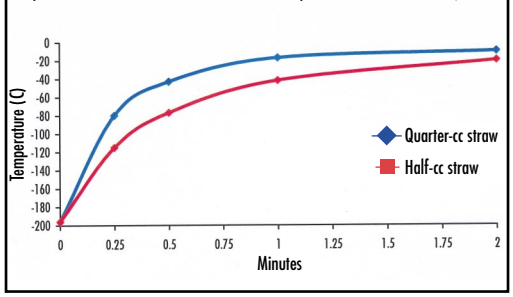
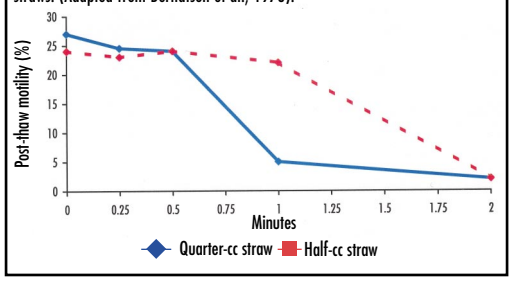


Figure 2. Effect of a one-time exposure to room temperature air (20 C) and then recooling on post-thaw motility of bovine sperm frozen in ¼- and ½-cc French straws. (Adapted from Berndtson et al., 1976).



The smaller diameter ¼-cc straw also was found to be more sensitive to heat and cold shock after thawing. This study suggests inseminators must exercise a greater degree of both pre- and post-thaw thermal protection during straw retrieval, gun assembly and A.I. when using ¼-cc straws to get optimum results.

These facts were major reasons for the U.S. A.I. industry's decision to use the ½-cc straw. Greater sensitivity of the ¼-cc straw to thermal insult and inseminator competence are of little significance in Canada and Europe, where more than 95 percent of all inseminations are performed by highly trained, professional technicians whose conception rates can be monitored routinely. However, in the United States, where most inseminations are performed by the herd owner or an on-farm inseminator, variation in inseminator skills and level of training will likely interact with straw type to affect conception rates.

Berndtson and coworkers cited a German study[4] that supports this interpretation, wherein non-return rates of ¼- and ½-cc straws were compared between "good" and "poor" technicians. While non-return rates of good technicians were similar for ¼- and ½-cc straws, poor technicians achieved higher non-return rates with ½-cc than with ¼-cc straws (see Table 1). Back in the late 1970s, the variation

in A.I. technician proficiency in the United States and its potential impact on semen quality and fertility was recognized as a strike against the smaller-diameter, more thermally sensitive 1/4-cc straws. This is still of great concern today.

Table 1. Summary of studies comparing the fertility of 1/4- and 1/2-cc straws.

Reference	Sub-group	Straw size: Quarter-cc	Straw size: Half-cc
		Percent pregnancies	
Select Sires, 1972 *unpublished*	None	65 (9,356)	66 (17,229)
Johnson et al., 1995	None	64 (679)	62 (681)
Kroetsch, 1992			
Study 1	20 x 106 sperm/dose	69 (2,770)	68 (3,000)
	30 x 106 sperm/dose	68 (2,286)	66 (3,035)
Study 2	None	66 (5,797)	66 (6,048)
Kupferschmied, 1972	"Good" technicians	71 (2,266)	70 (2,119)
	"Poor" technicians	66 (1,071)	70 (1,071)

Physical Advantages

The 1/2-cc straw is considered more user friendly than the 1/4-cc straw because it is easier to handle, and it's easier to read. There also is less breakage during straw retrieval from the storage tank. Supporters of the 1/4-cc straw point out that smaller straws require less storage space, which potentially can lower storage and shipping costs, and reduce the quantity of extender and antibiotics needed to process a given amount of semen. While these are valid points, all of these factors combined contribute only a small amount to overall straw production cost.

Pregnancy Rates

The argument that 1/4-cc straws result in slight increases in conception and pregnancy rates is a fallacy, as is the common misperception that the 1/4-cc straw has less semen.

Regardless of straw type, all reputable A.I. organizations adjust the semen-extension process and concentration of sperm such that both the 1/2- and 1/4-cc straw will have the same total number of live sperm. And the truth is, that's what's really most important—the total number of live sperm placed in the reproductive tract, not the straw size. The reality is that all straws (U.S., Canadian, European, 1/4- or 1/2-cc) contain two to four times more sperm than are necessary to get the cow pregnant.

Thus, any improvement in post-thaw survival imparted by the 1/4-cc straw may allow the A.I. center to achieve the same level of fertility at lower cell numbers per dose and thereby more efficient utilization semen from short-supply bulls. However, this should not be expected to translate into higher conception rates in the field. There are volumes of research to support this interpretation in addition to the direct comparison studies referenced in Table 1.

Summary

The 1/4-cc straw is absolutely capable of achieving conception rates comparable to those of the 1/2-cc straw if handled correctly. But the 1/4-cc straw is certainly nothing new, nor is it a short cut to higher conception rates.

The day may come that Select Sires considers converting to the 1/4-cc straws to take advantage of some of the benefits they impart. However, it will not be done under the illusion that our customers will realize higher conception. Consideration also will be given to customer preferences. In contrast to other countries, the variance in inseminator competence in the United States suggests that the potential for reduced conception rates with the 1/4-cc straw is a distinct possibility that must be considered prior to such a conversion. ◆

References

1. Berndston, W. E., B. W. Pickett and C. D. Rugg. 1976. Procedures for field handling of bovine semen in plastic straws. Proc. 6th NAAB Tech. Conf. Artif. Insemin. Reprod. pp 51-60.
2. Johnson, M.S., P. L. Senger, C. H. Allen, D. D. Hancock, B. M. Alexander and R. G. Sasser. 1995. Fertility of bull semen packaged in .25- and .5-milliliter French straws. J. Anim. Sci. 73:1914-1919.
3. Kroetsch, T.G. 1992. Experiences with mini-straws. Proc. 14th NAAB Tech. Conf. Artif. Insemin. Reprod. pp 64-67.
4. Kupferschmied, H. 1972. Untersuchungen uber die umstellung von mittleren auf feine pailletten in der rinderbeasamung. Zuchthygiene 7:67.

Select Hosts Reproductive Think Tanks and Advanced Training Sessions

These industry experts and Select Sires specialists participated in our first-ever Male Reproductive Physiology Think Tank, which was hosted by Select Sires in Columbus, Ohio, on Oct. 17. Earlier that month Select held its seventh annual Estrus Synchronization Think Tank in Columbus, attracting leading researchers from throughout the country. It is through cooperative research efforts with recognized experts that Select Sires has developed breeding systems that enable producers to get better results with A.I. And, our commitment to research and development doesn't stop there.

Federation employees regularly participate in advanced reproductive training seminars. The Select Sires reproductive-specialist seminar was timed to give employees exposure to the experts participating in Select's estrus-synchronization think tank. Also in October, Select's week-long national technician conference featured advanced classroom and hands-on training, including a semen-placement evaluation using ultrasound. Activities like these ensure that your Select Sires representatives can offer the expertise you need for reproductive success.