

Kiss of Death

Ubiquitin offers alternative fertility test.

Story & photo by **Troy Smith**

Ubiquitin is a protein so named because it is ubiquitous, or present everywhere. At least it is present in the cells of virtually all living beings. Ubiquitin performs a variety of roles important to cell division and immune function. Among scientists versed in cellular biology, ubiquitin is sometimes called the “kiss of death.”

That moniker is not as morbid as it sounds. It refers to ubiquitin’s necessary role in the elimination of other proteins. When ubiquitin becomes attached to certain proteins, they become targets to be broken down and destroyed by a cell’s waste-disposal mechanism.

Researchers have discovered that ubiquitin’s tattletale ways can be useful in evaluating semen quality and fertility in bulls. Also present in seminal plasma, ubiquitin can mark defective sperm cells that might go undetected by other semen evaluation methods, says Peter Sutovsky, reproductive physiologist at the University of Missouri-Columbia and the inventor of technology capable of detecting sperm cells tagged by ubiquitin.

“Appearances can be deceiving,” Sutovsky says, referring to commonly used techniques to evaluate semen samples for sperm morphology and motility. He says even well-trained and experienced evaluators can be fooled and miss large numbers of defective sperm cells because current methods are subjective or detect only certain types of sperm abnormalities.

“Using ubiquitin, we can detect bad sperm cells that otherwise appear normal,” he adds. “This technology applies a negative marker approach. The presence of ubiquitin in a semen sample relates to negative fertility. Basically, increased ubiquitin indicates increased cell abnormality.”

Take a look

In simple terms, here’s how it works. Secreted by the epididymis in male mammals, ubiquitin becomes attached to the surface of sperm cells deficient in proteins associated with fertility. When semen samples are exposed to a green dye, ubiquitin takes on the color and, in effect, glows in the dark. Levels of fluorescence reflect the abundance of ubiquitin-tagged, defective sperm cells. The fluorescence can be measured with a specialized, laser-equipped microscope called a flow cytometer.



► Ubiquitin can mark defective sperm cells that might go undetected by other semen evaluation methods, says Peter Sutovsky, reproductive physiologist at the University of Missouri-Columbia.

Sutovsky says the technology is used in human fertility evaluation, as well as for evaluating stallions. He believes it offers several advantages over traditional techniques for evaluating bull semen:

- Ubiquitin-based assays recognize defective sperm cells that appear to be morphologically normal under standard light microscopic evaluation.
- Automated morphology and motility evaluation can deliver variable results, depending on the length of time between collection and evaluation, but ubiquitin-based assays are not affected by sample handling or storage.
- Ubiquitin-based assays recognize sperm with DNA damage and other defects.
- Stain-based assays depend on the uptake of dye by live, presumably fertile sperm cells. Ubiquitin-based evaluation is not biased toward live or dead sperm, and normal sperm damaged during sample collection or storage will not be falsely identified as defective.

Furthermore, Sutovsky says repeated studies suggest that increased sperm ubiquitin levels coincide with reduced fertility in breeding bulls. So, along with evaluating semen quality, ubiquitin levels may be useful in predicting future bull fertility.

“The assay is relatively easy and low-cost,” Sutovsky adds. “And while it shows distinct advantages over other methods, it is possible that a combination of ubiquitin evaluation with one or more other methods would provide the most comprehensive testing of bulls.”

