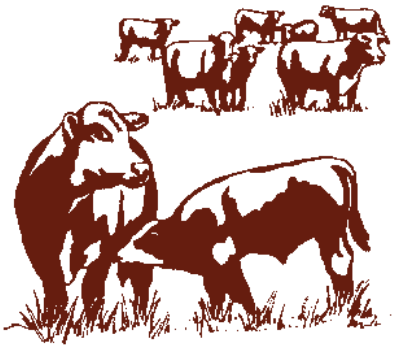
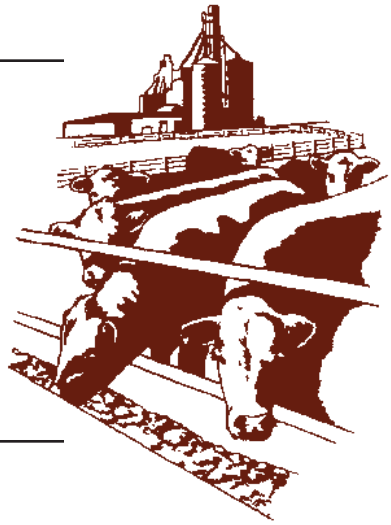


Beef Cattle Handbook



BCH-2400 Product of Extension Beef Cattle Resource Committee

Using Ultrasound Technology in Beef Cattle Reproductive Management

Doug Zalesky, Ph.D., Extension Beef Specialist, South Dakota State University
W. E. Beal, Ph.D., Reproductive Physiologist, Virginia Polytechnic Institute and State University

Reproductive performance and efficiency in a cow-calf operation is one of if not the most important factor that affects profitability. Achieving optimum levels of reproductive performance and subsequently high levels of reproductive efficiency should be the top goal of any cow-calf operation.

Obtaining profitable levels of performance and efficiency require that producers continually evaluate new technologies and tools that become available to them.

One tool that has recently become available for use in beef cattle production is ultrasonography. While this is not a new technology, its application to the beef industry is more recent. Since its first application with live animals in 1950 (J.J. Wild), ultrasound has gained increased use in the livestock industry. Areas of application in the beef industry include: carcass trait measurements in live animals, veterinary medicine and reproductive management.

Ultrasound Technology

Ultrasound technology is a non-invasive, non-destructive, humane tool that can be used on live animals. Ultrasonography utilizes high frequency sound waves to produce images of tissues and internal organs. The high frequency sound waves are produced by vibrations of specialized crystals (piezoelectric crystals) located in an ultrasound probe or transducer. These waves are emitted from the transducer and are directed toward the tissues or structure of interest. The tissue or structures ability to reflect the sound waves will determine its ultrasonic characteristics. Reflected sound waves are sent back to the transducer, converted to electric current and subsequently appear as an echo image on the viewing screen of the ultrasound machine.

The echo image on the screen will appear in varying shades of gray (black to white). The shade of gray is determined by the density of the tissue encountered by the sound waves and subsequently the amount of sound waves reflected back to the transducer. Tissue or structures can be classified as either echogenic or non-echogenic in their capacity to reflect sound waves. Echogenic structures reflect some or most of the sound waves, depending on their density. The denser the tissue, the more sound waves are reflected and the more white the image will appear on the screen. Since bone is the most dense tissue in the body it will appear as very white on the screen. Fluids do not reflect sound waves and hence are non-echogenic. Such structures (embryonic vesicles, ovarian follicles) will appear as black areas on the screen.

Close proximity of the reproductive tract of the cow to the rectal wall allows for the use of transrectal imaging and the use of high frequency (3.5, 5.0 and 7.5 Mhz) transducers to provide detailed images. As frequency of sound waves generated increases, the resolution of the image improves, however, the depth of penetration of the sound waves decreases. Transrectal scanning requires similar precautions and preparation as traditional rectal palpation. The use of a couplant, both as a lubricant and to eliminate air between the transducer and the rectal wall (air reflects sound waves) is required. Experience is extremely important in proper image production as well as interpretation of the image, since many artifacts can cause poor images and incorrect interpretations.

Imaging of Ovarian Activity

Non-cycling females during the breeding season are one of the biggest factors that reduces reproductive efficiency in a cow herd. Certainly increasing the number of females cycling or hastening conception would improve reproductive efficiency in a given herd. Determining which females are cycling before or during the breeding season would provide useful information to improve reproductive management. Ultrasound imaging can provide such information.

Knowledge of the reproductive status of breeding females with ultrasound imaging provides two advantages. First, visual confirmation of the presence or absence of ovarian structures such as follicles and corpora lutea indicate whether a female is cyclic or non-cyclic. Subsequently, the most efficacious treatment for estrous control can be determined. Secondly, diagnosis of abnormal ovarian (cysts) or uterine (pyometra) conditions that can impair fertility can be diagnosed. While the above mentioned diagnoses can be made with conventional rectal palpation, research reports indicate more accurate diagnosis with ultrasound.

The most useful times to utilize ultrasound for monitoring ovarian activity appears to be, prior to the start of the breeding season, and with the use of A.I., 30-35 days before the end of the A.I. season. In both instances, knowledge of whether a female is cyclic or non-cyclic can lead to selection of the most desirable treatment to synchronize or induce estrus.

Pregnancy Determination

Detection of pregnancy with ultrasonography provides two potential advantages over traditional palpation. The first is earlier detection of the presence of an embryo and secondly, increased speed and accuracy of detecting early pregnancies. Research reports indicate that pregnancies can be detected as early as day nine with ultrasonography, however, accuracy is no better than a random guess (<50%) at that early stage. Accuracy of detection improves dramatically as the age of the fetus increases to day 18 (85%), day 20 (100%) and day 22 (100%). These numbers indicate that detection of pregnancy by ultrasound should be done after the fetus is at least 20 days of age. Confirmation of the presence of a fetus includes the visualization of a fluid filled cavity containing a viable fetus within one of the uterine horns.

While ultrasound can be used to detect pregnancy throughout the gestational period, its real advantage is earlier detection (days 25-60) when compared to conventional rectal palpation. Accuracy of ultrasound at this early time is 100 percent when an experienced technician is utilized. In current production systems most cows are palpated for pregnancy when fetuses are an average of 60-120 days of age. Earlier pregnancy detection with ultrasound offers the producer an earlier chance to make management decisions regarding open cows and heifers. Such decisions could lead to a reduction in overhead and feed costs by identifying and culling open cows sooner than normal.

Embryo Development

Ultrasound imaging allows for more accurate determination of the age of the fetus. Several characteristics of the fetus can be detected at specific time points to allow precise aging of the fetus. Some examples of these include: the heartbeat (day 22); the spinal cord (day 28); the placentomes (day 35); split hooves (day 44); and the ribs (day 52).

In addition, the heartbeat can be used to determine the presence of a viable or non-viable embryo as early as day 22. In the event that a non-viable embryo is present and the female maintains a functional corpus luteum, she will continue as if pregnant. Such information, provided by ultrasonography, allows for administration of treatments for expulsion of the nonviable embryo and regression of the corpus luteum. Such treatments aid in getting cows back into heat and rebred sooner than without such information and treatments.

Embryo Sexing

Ultrasound imaging allows for determination of the sex of a fetus by evaluating the relative position of the genital tubercle (penis or clitoris) and development of genital swellings into a scrotum in male fetuses.

Accuracy of fetal sexing is high (92-100 percent) when ultrasound imaging is properly timed. The "best' window of opportunity for determination of fetal sex appears to be days 55-70 for large framed cows, and days 60-80 for cows of smaller frame size. Two events can occur if imaging is done outside of these windows for optimum success. First, manipulation of the fetus relative to the transducer becomes more difficult as the fetus gets older. Secondly, as the gravid uterus becomes enlarged, it descends over the pelvic rim into the body cavity and requires retraction of the uterus.

Application of fetal sexing is more likely suited for the purebred or seedstock portion of the industry, especially if used in conjunction with embryo transfer. Such application would allow for marketing of male and female fetuses while still in utero. For the commercial producer, application is likely limited to identifying and selecting females with male calves. Management for this purpose on most commercial operations is not feasible.

Monitoring Artificial Insemination Technique

Training programs for artificial insemination typically utilize excised reproductive tracts from cows for use in training proper semen deposition. Proper semen deposition and proper training of technicians is important for their subsequent performance and the success of A.I. A method to improve the training and retraining of inseminators was developed utilizing ultrasound for evaluation of simulated semen deposition in live cows.

Briefly this method involves the use of a brass bead that has a nylon line attached to it. The bead fits into the end of a slightly modified insemination rod and is deposited in the reproductive tract by the trainee. Ultrasound scanning of the reproductive tract then

allows for evaluation of proper placement. After the scan has determined the location of the bead, it is removed from the tract by pulling the nylon line out and the bead can be reused.

Monitoring the Male Reproductive System

Considerably less ultrasound imaging of the male reproductive system has been done. Normal testes anatomy and some disease conditions have been described. However, no work has been done to determine the potential for use of ultrasonography to help predict a bulls future breeding potential. Future work should determine if testicular ultrasound can predict the quality and/or quantity of sperm production and if incorporation of ultrasound imaging can be routinely incorporated into breeding soundness evaluations of bulls.

Summary

Potential uses for ultrasound technology in beef cattle reproductive management seem to be many. The primary areas of potential application seem to be in the areas of ovarian activity and pregnancy determination. Utilization in these areas should have the biggest impact on reproductive efficiency because of better management for synchronizing or inducing estrus and in improved, early pregnancy detection skills.

Ultrasound technology offers yet another tool that has potential to improve reproductive efficiency through better reproductive management. As is the case with all potential tools, they must be thoroughly evaluated before being utilized. Such an evaluation should include potential use and cost.

References

1. Beal, W.E., R.C. Perry and L.R. Corah. 1992. "The Use of Ultrasound in Monitoring Reproductive Physiology of Beef Cattle." *J. Anim. Sci.* 70:924.
2. Ginther, O.J. 1986. "Ultrasonic Imaging and Reproductive Events in the Mare." O.J. Ginther (Ed.). Equiservices, Cross Plains, WI.
3. Zalesky, D.D. 1993. "Using Ultrasound Technology in Reproduction Management." *Proc. Range Beef Cow Symposium XIII,* p. 168, Cheyenne, WY.

Author:
Doug Zalesky, Ph.D., Extension Beef Specialist, South Dakota State University
W. E. Beal, Ph.D., Reproductive Physiologist, Virginia Polytechnic Institute and State University

This publication was prepared in cooperation with the Extension Beef Cattle Resource Committee and its member states and produced in an electronic format by the University of Wisconsin-Extension, Cooperative Extension. Issued in furtherance of Cooperative Extension work, ACTS of May 8 and June 30, 1914.