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Challenges Associated with Semen Quality While Collecting Beef Bulls for Semen Freezing

A. R. Hartman
Kansas State University, arhartma@k-state.edu

N. M. Goodenow
Kansas Artificial Breeding Service Unit, Manhattan, KS, ngoodenow@k-state.edu

S. K. Tucker
Kansas Artificial Breeding Service Unit, Manhattan, KS, sktucker@k-state.edu

See next page for additional authors

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Challenges Associated with Semen Quality While Collecting Beef Bulls for Semen Freezing

Abstract

Objective: The objective of this study was to evaluate the frequency of failure to freeze semen due to semen quality.

Study Description: Semen collection data from 2008 to 2018 were obtained from the Kansas Artificial Breeding Services Unit and consisted of 14,750 ejaculates from bulls. Bulls were collected twice weekly on Mondays and Thursdays with an artificial vagina. Bulls not receptive to the artificial vagina were subject to electro-ejaculation. A single technician was responsible for all pre-freeze and post-thaw semen analysis. Ejaculates were required to meet quality standards for both progressive motility and morphology.

Results: Over the ten years, 21% of ejaculates met all freezing quality standards, 11% of all ejaculates collected did not have a high enough motility to be considered satisfactory for a breeding soundness exam (BSE), and 63% of all ejaculates did not reach the motility quality threshold for freezing. Ejaculates from bulls ≤ 12 months of age produced ejaculates that would not meet satisfactory levels of a BSE 15% of the time. Ejaculates from bulls 13–18 months of age produced unsatisfactory ejaculates for motility for a BSE 6% of the time. When evaluating primary sperm abnormalities, 87% of ejaculates had less than 20% primary sperm abnormalities. Ejaculates from bulls ≤ 12 months of age produced the highest amount of ejaculates failing due to primary abnormalities with 24%, while bulls ≥ 31 months of age produced the least amount of ejaculates failing due to primary abnormalities at 10% of ejaculates. When evaluating total sperm abnormalities per ejaculate, 77% of ejaculates met the threshold of less than 30% total abnormalities. Ejaculates from bulls ≤ 12 months of age failed to meet the total sperm abnormality threshold 28% of the time. These results highlight one of the main difficulties of collecting freezing quality semen, in which semen meets the standards of normal spermatozoa but where most samples do not meet needs for progressive motility.

The Bottom Line: Of over 14,000 collections, only 21% met all requirements for freezing semen, approximately 63% did not meet progressive motility freezing standards, and 11% did not meet the satisfactory level of a BSE.

Keywords

breeding, soundness exam, motility, sperm abnormalities

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Cover Page Footnote

We appreciate the Kansas Artificial Breeding Services Unit's crew and customers for providing their data and insight to make this project possible.

Authors

A. R. Hartman, N. M. Goodenow, S. K. Tucker, K. E. Fike, and D. M. Grieger

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K-STATE Research and Extension

CATTLEMEN'S DAY 2022

KANSAS STATE UNIVERSITY CATTLEMEN'S DAY

Challenges Associated with Semen Quality While Collecting Beef Bulls for Semen Freezing

A.R. Hartman, N.M. Goodenow,[1] S.K. Tucker,[1] K.E. Fike, and D.M. Grieger

Abstract

The objective of this study was to evaluate the frequency of failure to freeze semen due to semen quality. Semen collection data from 2008 to 2018 were obtained from Kansas Artificial Breeding Services Unit. A single technician was responsible for all semen analysis. Ejaculates were required to meet quality standards for both progressive motility and morphology. Of the ejaculates collected, 21% met all requirements for freezing semen. Over the ten years, 11% of all ejaculates collected did not have a high enough motility to be considered satisfactory for a breeding soundness exam (BSE), and 63% of all ejaculates did not reach the motility threshold for freezing. Bulls ≤ 12 months of age produced ejaculates not satisfactory for a BSE 15% of the time. Bulls 13–18 months of age produced ejaculates unsatisfactory for progressive motility for a BSE 6% of the time. Ejaculates from bulls 13–18 months of age had a 58% failure rate while ejaculates from bulls ≥ 31 months of age failed 67% of the time with ejaculates from bulls ≤ 12 months of age or 19–30 months falling in between. When evaluating primary sperm abnormalities, 87% of ejaculates had less than 20% primary sperm abnormalities. Ejaculates from bulls ≤ 12 months failed to pass due to primary abnormalities 24% of the time, while ejaculates from bulls ≥ 31 months produced the least amount of primaries at 10%. When evaluating total sperm abnormalities per ejaculate, 77% of ejaculates met the threshold of less than 30% total abnormalities. Ejaculates from bulls ≤ 12 months of age failed to meet the total sperm abnormality threshold 28% of the time. These results highlight one of the main difficulties of collecting freezing-quality semen, in which semen meets the standards of normal spermatozoa but where most samples do not meet needs for progressive motility.

Introduction

Bull breeding soundness exams (BSE) are typically performed on yearling bulls and annually on herd bulls. Many producers have come to expect an industry average BSE failure rate of 20% in yearling bulls (Bagley and Burrell, 1997). What has not yet been well documented are the reasons and expectations as to why bulls in a collection facility do not produce semen to meet freezing standards. While most bulls in a collection facility may pass a BSE, this does not mean their semen will meet the more stringent qualifications for freezing semen. To better understand why bulls fail to produce better

[1] Kansas Artificial Breeding Service Unit, Manhattan, KS.

quality semen, the objective of this study was to evaluate the frequency of failure to freeze semen due to semen quality.

Experimental Procedures

Data were provided from Kansas Artificial Breeding Services Unit, and bulls were collected from January 2008 to December 2018. A total of 14,750 ejaculates from 906 bulls were provided for analysis. Bull birth dates were provided, and bull age was calculated as months of age from birthdates supplied until the collection date of each ejaculate. Once bull age was determined, bulls were assigned to one of four age groups: ≤ 12 months, 13–18 months, 19–30 months, and > 60 months. Bulls were collected twice weekly on Mondays and Thursdays, with the preferred collection method, artificial vagina. Bulls at this facility, not receptive to the mount steers or the artificial vagina after 3 or 4 attempts, were subject to electro-ejaculation to ensure ejaculates were collected.

Once an ejaculate was collected, a single technician at Kansas Artificial Breeding Services Unit was responsible for all pre-freeze and post-thaw semen analysis. Ejaculates were required to meet quality standards which included pre-freeze progressive motility of equal to or greater than 50%. The ejaculates could not contain greater than 30% abnormal spermatozoa and must have had a progressive motility of at least 30% post-thaw to pass freezing quality standards. All ejaculates that passed the initial assessment were extended and frozen in half cubic centimeter straws. The descriptive information provided for each ejaculate was progressive motility prior to freezing, progressive motility post-freezing, and primary and secondary sperm abnormalities.

Although these samples were collected to freeze semen, for this project, we set secondary quality standards based on the bull BSEs from the Society of Theriogenology (Society of Theriogenology, 2018). The threshold to be considered a satisfactory breeder for progressive motility is 30% or greater, and with sperm abnormalities of less than 30% total morphological abnormal sperm, with less than 20% of those being head defects (Society of Theriogenology, 2018).

Collection characteristics were evaluated using multiple frequency models in Statistical Analysis System. The frequency models were utilized to assess the overall distribution of ejaculates' likeliness to pass a BSE and be acceptable for freezing semen. Age groups within each semen characteristic were then analyzed for their likeliness to meet these quality thresholds.

Results and Discussion

Over the ten years, 21% of all ejaculates collected met the freezing quality standards of 50% progressive motility pre-freeze, 30% progressive motility post-freezing, and the sperm morphology requirements of less than 30% abnormal spermatozoa, with less than 20% of those being from primary sperm abnormalities (Figure 1). When evaluating ejaculates for progressive motility, 11% of all ejaculates collected did not have a high enough progressive motility (≥ 30%) to be considered satisfactory for a BSE, and 63% of all ejaculates did not reach the initial progressive motility threshold for freezing (≥ 50%). Of ejaculates collected from bulls ≤ 12 months of age, 15% did not meet minimum progressive motility requirements of a BSE, which is 30% (Figure 2). Bulls 13–18 months of age produced unsatisfactory ejaculates for progressive motility for a

BSE 6% of the time, and ejaculates from bulls 19–30 months of age did not meet the standard 10% of the time. Ejaculates collected from bulls ≥ 31 months of age failed to meet BSE progressive motility standards 14% of the time. When evaluating ejaculates' likeliness to be acceptable for freezing semen, the percentage of ejaculates that met the quality stands was much lower. Ejaculates collected from bulls ≤ 12 months of age failed to meet freezing quality progressive motility 64% of the time, while ejaculates from bulls 13–18 months old failed 58% of the time, and ejaculates from 19- to 30-month old bulls failed 61% of the time. Ejaculates from bulls ≥ 31 months of age did not meet the progressive motility threshold 67% of the time. Failure of bulls to produce freezing-quality semen may be explained by several factors. It has been previously reported that as bulls age, they experience a reproductive decline in motility (Barth and Walder, 2002; Snoj et al., 2013). These results suggest that when collecting bulls ≤ 12 months and ≥ 31 months of age, progressive motility may be a challenge in collecting freeze quality semen.

For bulls whose ejaculates were of freezing quality for both pre-freeze and post-freeze progressive motility, those samples were evaluated for percentage of abnormal spermatozoa. When evaluating ejaculates for primary sperm abnormalities, 87% had less than 20% primary sperm abnormalities, which would be considered satisfactory for a BSE and for freezing semen (Figure 3). Unlike the results for motility as bulls aged, the percentage of primary abnormalities in the ejaculates decreased, suggesting an increase in ejaculate quality. Ejaculates from bulls ≤ 12 months of age had the greatest number of primary abnormalities with 24%, while ejaculates from bulls ≥ 31 months of age had the least percentage of primary abnormalities with 10%.

When evaluating total sperm abnormalities per ejaculate, 77% of ejaculates met the threshold of less than 30% total abnormalities (Figure 3). Ejaculates from bulls ≤ 12 months of age failed to meet the total sperm abnormality threshold 28% of the time. Ejaculates from bulls 13–18 and 19–30 months of age failed to meet the total abnormality threshold 25% of the time, and ejaculates from bulls ≥ 31 months of age only failed to meet the standard 20% of the time. The percentage of ejaculates failing to meet abnormality thresholds was comparable to research findings from others (Bruner et al., 1995). These results highlight one of the main difficulties of collecting freezing quality semen, in which semen meets the standards of normal spermatozoa but where most samples do not meet needs for progressive motility.

Implications

Of over 14,000 collections, only 21% met all requirements for freezing semen, approximately 63% did not meet progressive motility freezing standards, and 11% did not meet the satisfactory level of a BSE.

Acknowledgments

We appreciate the Kansas Artificial Breeding Services Unit's crew and customers for providing their data and insight to make this project possible.

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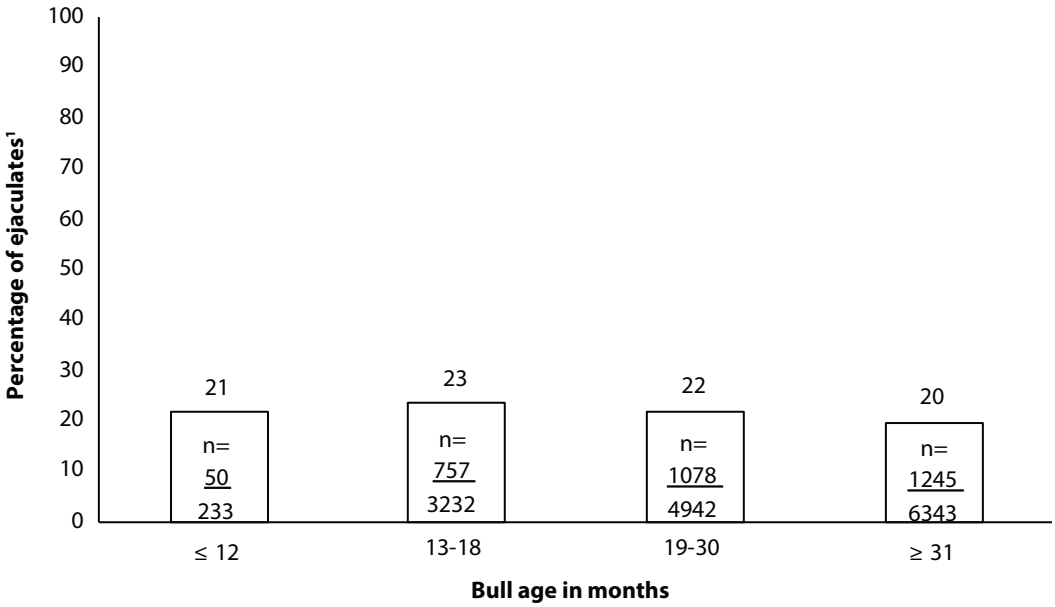

Figure 1. Percentage of all ejaculates meeting motility and morphology requirements for freezing. All ejaculates meeting freezing requirements were required to meet a pre-freeze progressive motility of 50%, a post-thaw progressive motility of 30%, have less than 20% primary sperm abnormalities, and less than 30% total sperm abnormalities. [1]Percentage of ejaculates is based on total ejaculates collected per age group divided by total of ejaculates passing the freezing quality standards.

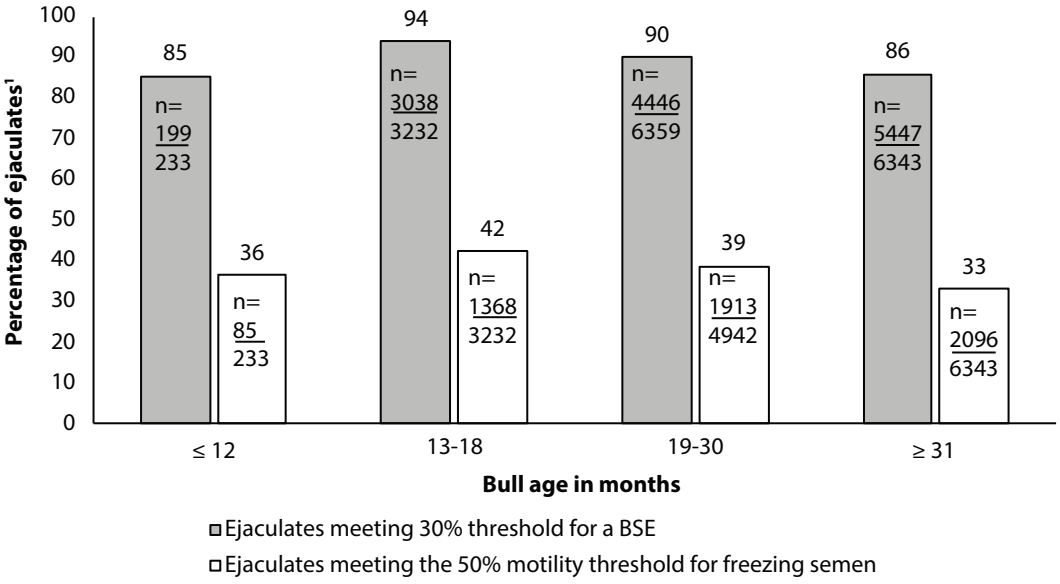

Figure 2. Percentage of ejaculates considered satisfactory for progressive motility during a breeding soundness exam or when freezing semen. Progressive motility must meet a minimum of 30% to be considered satisfactory for a BSE, and 50% to meet the standards for semen pre-freeze quality. [1]Percentage of ejaculates is based on total ejaculates collected per age group divided by total of ejaculates meeting the specific progressive motility requirements.

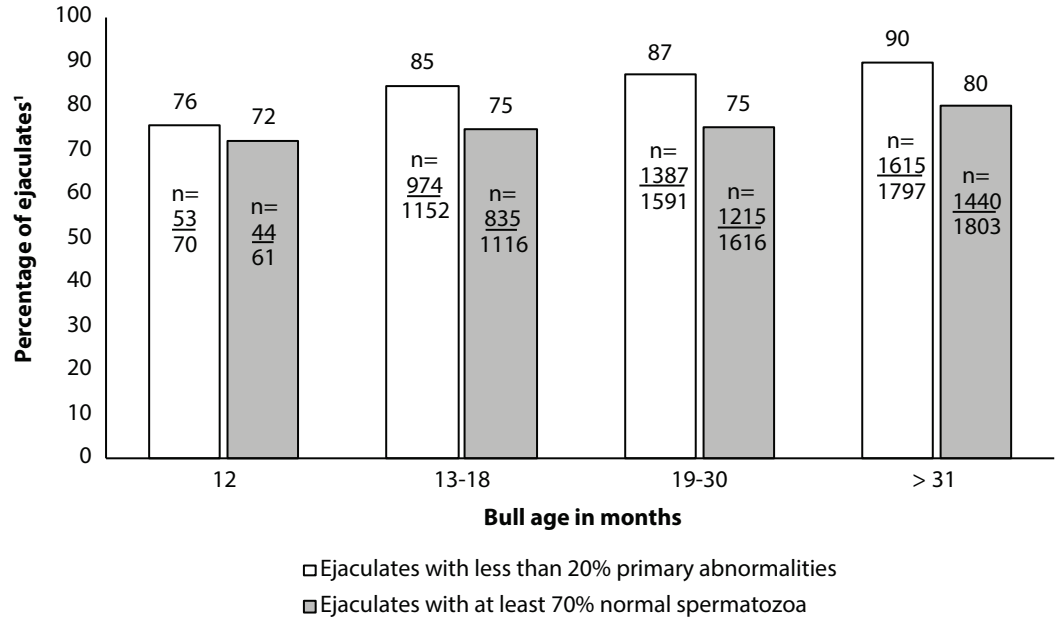

Figure 3. Percentage of ejaculates meeting primary and total abnormal spermatozoa requirements after ejaculates have previously met freezing progressive motility standards. All ejaculates in the analysis had met both the pre-freeze progressive motility standard of 50%, and the post-thaw progressive motility standard of 30%. [1]Percentage of ejaculates is based on total ejaculates that passed pre-freeze and post-thaw standards collected per age group divided by total of ejaculates meeting the specific sperm abnormality requirements.