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Reproductive Aging Influences Ovarian Function in Beef Cows

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Summary

Anti-Müllerian Hormone (AMH) has been associated with follicle number and age of the ovary. Therefore, our hypothesis was that AMH was a biomarker for both follicle number and ovarian function in the beef cow. Ovaries were collected by flank laparotomy. The number of follicles increased as cows aged from 1.5 to 6 years and began to decrease thereafter; however, the size of the ovary continued to increase with advanced age. Expression of the AMH gene increased with increasing follicle number in 2-year-old beef cows. These results suggest that heifers with larger ovaries will have greater numbers of follicles and greater productivity, allowing them to stay in the production herd longer. AMH could be used to identify heifers of high reproductive potential at a very young age.

Introduction

Fertility declines in mammalian females as they age, mainly due to depletion of the number of follicles in the ovary. Early studies demonstrated that Hereford heifers were born with approximately 100,000 follicles in their combined ovaries, but there was a great deal of variation among heifers in the number of follicles in their ovaries at birth. Low follicle number is associated with decreased heifer pregnancy rate, poor oocyte quality, decreased superovulatory response, impaired corpus luteum

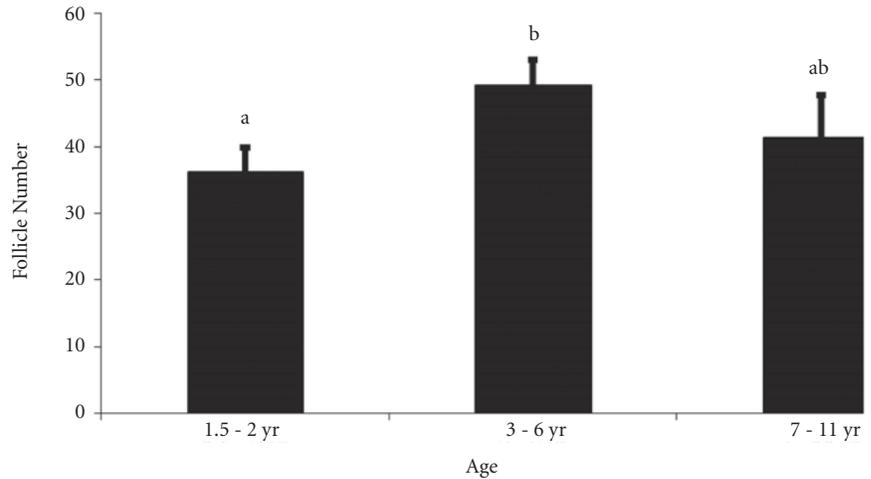


Figure 1. Influence of age on surface follicle numbers in the bovine ovary. Follicle numbers were greater in mature cows than in heifers, and began to decrease in cows of advanced age ($P = 0.04$).

Table 1. Influence of age on ovarian traits in beef cows.

Trait	Age			P-value
	1.5 - 2 yr	3 - 6 yr	7 - 11 yr	
No. of cows	25	248		
Ovarian weight (g) ¹	11.8 ± 0.9 ⁴	17.2 ± 1.0 ⁵	22.5 ± 1.6 ⁶	0.0001
Ovarian length (mm) ²	28.1 ± 0.9 ⁴	31.2 ± 0.9 ⁵	33.0 ± 1.5 ⁶	0.008
Ovarian height (mm) ³	19.6 ± 0.6 ⁴	21.3 ± 0.6 ⁵	24.0 ± 1.0 ⁶	0.001

¹Sum of the weight of the combined ovaries.

²Average length of the left and right ovary within a cow.

³Average height of the left and right ovary within a cow.

^{4,5,6}Within a row, means with different superscripts are different.

function, and increased ovulation failure in beef cows. Anti-Müllerian Hormone is a growth factor that has been demonstrated to be both a biological and genetic marker of ovarian function and follicle numbers in other mammalian females. Therefore, we hypothesized that AMH could act as a biomarker and genetic marker of follicle number in beef cows.

Procedure

All procedures were approved by the Animal Care and Use Committee (IACUC) at the University of Nebraska–Lincoln. Beef cows ($n = 37$) ranging in age from 1.5 to 11 years were injected with Lutalyse, and ovaries were removed by flank laparotomy (incision in the flank through

the side to excise the ovaries) 36 hours later to obtain dominant follicles prior to ovulation. Ovaries were weighed, measured for length and height, and all visible surface follicles were counted. The outer cortical region of the ovary that contains the follicles was dissected and a representative piece was frozen for genomic analysis.

Results

The number of follicles was greater in mature cows than in cows less than 3 years of age; however, beyond 6 years of age, follicle numbers declined (Figure 1). Interestingly, although follicle numbers declined, ovarian size continued to increase in cows of advanced age (Table 1). In general, larger ovaries were associated with

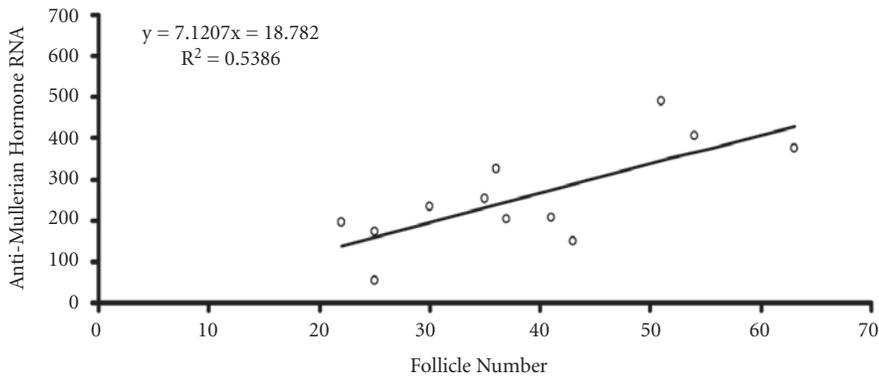


Figure 2. Relationship between relative level of AMH gene expression and follicle numbers in the ovarian cortex of the 2-year-old beef cow. As the number of follicles increased, the amount of AMH RNA increased ($P = 0.01$).

increased follicle numbers in heifers.

These results suggest that cows that are productive to an advanced age have larger ovaries and larger numbers of follicles than do heifers. This would explain why ovarian size appears to be increasing as follicle number is beginning to decrease.

Within the ovarian cortex of 2-year-old cows, AMH gene expression increased as follicle numbers increased (Figure 2). Similar results have been observed in rodents, primates, and women. Additionally, polymorphisms in the human AMH gene have been associated with follicle

numbers and ovarian dysfunction. The results of the present study suggest AMH may be a genetic marker of follicle number and ovarian function in the beef cow as well, and DNA sequencing efforts have begun. Genetic markers would be useful for identifying heifers of high reproductive potential at a young age, before ultrasonography is viable. This would allow culling decisions to be made before time and resources were wasted on heifers with low reproductive potential.

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