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Investigating RFI interactions upon pregnancy diagnosis in Angus heifers

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Introduction

Residual Feed intake (RFI) is associated with energy metabolism whereby low RFI (high efficient) animals require less energy and produce less methane per pound of gain than high RFI (low efficient) animals [1]. The selection for low RFI has an impact on the way an animal acquires, metabolizes and distributes energy, although all of the underlying changes and mechanisms are not yet fully understood [2,3]. The impact, whether positive or negative, of breeding for low RFI animals on other traits such as fertility, health and longevity is even lesser known.

A few studies have investigated the interaction of RFI and reproduction traits, and a slight negative correlation between inefficient animals and reproductive traits such as longer gestation length, later onset of puberty, and lower conception rates have been noted (4,5,6,7,8). Yet it has been observed that correcting RFI measurements for backfat thickness and activity level can alleviate this correlation (9). It has been suggested that one issue with the current industry standard of RFI testing is that is favours later maturing animals, which in turn can negatively impact reproductive traits (6,7,8).

Bull fertility and RFI has been investigated to an even lesser degree than heifer and cow fertility. Two studies reported no correlation between RFI and scrotal circumference (SC) (4,10), while a third has reported reduced sperm motility, sperm viability and SC in negative RFI bulls compared to their positive RFI counterparts (11). A fourth study reported a slight decrease in sperm motility in negative RFI bulls, yet they sired more progeny than their positive RFI counterparts (12).

Therefore, the objectives of this analysis were:

- To investigate the effect and interaction between RFI and conception rate after the first artificial insemination event;
- To investigate the effect and interaction between RFI and overall pregnancy rate.

Materials and Methods

- Over 2 years 173 purebred Angus heifers were tested for RFI corrected for back fat thickness (RFIF) in GrowSafe™ System [9] at the University of Alberta Kinsella Ranch. They were distributed into positive (year 1 N=42; year 2 N=45) and negative (year 1 N=42; year 2 N=44) RFIF groups.
- Heifers from each RFIF group were bred to one of two bulls with the same RFI classification to produce calves with divergent genetic potential for RFI. Heifers were synchronized using CIDRs®, Estrumate™ and Fertiline™ and bred through a timed artificial insemination (1st AI) and heat detection (2nd AI).
- Pregnancy was determined at 28 days post AI using trans-rectal ultrasonography (Aloka-500V scanner equipped with a 7.5 MHz linear transducer; Aloka Co., Tokyo, Japan),.
- Using PROC CATMOD of SAS, the effect and interaction of the year (1 or 2), RFIF and sire bred to (Bismark, Commander, Gameday or Illini), upon overall pregnancy rate after 2 rounds of AI, and conception rate after the first timed AI, were investigated.

Results

Table 1: Statistical analysis of the influences of Sire, Year, RFIF, and their interactions, on conception rate after the 1st estrous synchronization and timed AI and overall pregnancy rate after 2 rounds of AI.

Effect	P-value	
	Conception after 1st AI	Overall Pregnancy Rate
Sire	0.134	0.201
Year	0.496	0.234
Sire*Year	0.556	0.221
RFIF	**0.007**	**0.080**
RFIF*Sire	**0.075**	0.134
RFIF*Year	0.288	**0.050**
RFIF*Sire*Year	0.242	0.311

- For conception rate after the first AI RFIF was significantly different (P<0.05), however there was also a near significant interaction between RFIF and sire (P<0.1)(Table 1).
- Analysis of overall pregnancy rates revealed that RFIF tended to be significant (P<0.1), and there also tended to be a significant interaction between RFIF and year (P<0.1)(Table 1).

Discussion

- The above results indicate that despite having corrected RFI for fat, differences in conception rates and overall pregnancy rates were observed in the heifers of this study. Basarab et al. (2011) adjusted RFI for backfat thickness and activity and reported no difference in average age of puberty yet numerically the average age was different. While conception rate and age of puberty are not the same trait, it has been shown that pregnancy rates are higher at the third estrus versus the first (13). Although the heifer has reached puberty, sexual maturation continues to occur through further growth and development of the uterus. It has been shown that regardless of oocyte quality, pregnancy rates increase in subsequent estrus cycles after reaching puberty (14), which may be partly due to increased circulating progesterone from the corpus luteum, which aids the uterus to mature, after the subsequent estruses after puberty (15).
- Heifer RFIF had an effect on both conception-related traits analyzed above. However, there are other factors to consider, especially since conception rates also tended to be significantly affected by interactions between RFIF with both year and sire (P<0.1, table 1). While Wang et al. (2012) observed that RFI classification had no effect on siring ability, Awda et al. (2013) noted fertility differences between bulls with divergent RFI. In our study it was noted that numerically there was a decrease in both conception after the first AI and overall pregnancy rates when comparing year 1 to 2, with a marked difference in one bull in particular. Therefore semen quality appeared to be a major influence on pregnancy rate in year 2. Therefore, cumulative pregnancy rates over both years for the sires varied greatly from each other as well as within their RFI classification. Since the effects of heifer RFIF, and Sire RFI cannot be separated, pinpointing the exact cause of the differences in conception rates is difficult.

Conclusions

RFIF did have a significant effect on the conception rate after the first AI, and tended to be significant in overall pregnancy rate. However, trends in significant interactions were observed between RFIF and year for overall pregnancy rate as well as RFIF and sire for conception after first AI. Further research is needed before a conclusive statement can be made regarding RFI and its impact, whether positive, negative or neutral, on reproduction.

In order to further investigate the interaction between RFI and reproduction, closer analysis of male and female reproductive traits is needed. The analysis of reproductive characteristics of the divergently selected offspring will hopefully shed more light on the interaction of RFI and reproduction. Investigating scrotal circumference and semen quality analyses for the bulls while analysis of onset of puberty and circulating progesterone levels at the time of breeding in heifers would aid in this regard.

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