

Preliminary Evaluation of Administration Site of Two Manufacturer's Reproductive Hormones on Induction of Ovulation in Postpartum Dairy Cows

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Summary and Implications

Synchronization of ovulation is a common reproductive management practice in the US dairy cattle industry. The objective of this study was to compare two different sites of hormone administration (intralabial versus intramuscular) and two different manufacturers (Parnell versus Zoetis) of the reproductive hormones gonadotropin releasing hormone (GnRH) and prostaglandin F_{2α} (PGF) on the efficacy of ovulation induction. Holstein cows (n=388) were enrolled in a pre-synch/ovsynch protocol during this 14-month study. Ultrasonographic observation of ovaries was made eight days after timed artificial insemination (TAI). Overall, treatment had no effect on the proportion of cows (90.0%) that ovulated in response to treatment. The incidence of double ovulations was 20.6% but was not affected by treatment. Similarly, treatment had no effect on the incidence of ovarian cysts (8.8%). Results revealed that failure to ovulate in response to exogenous hormone treatment caused a 10% reduction in potential pregnancy rate. There was no difference in efficacy of ovulation induction due to manufacturer of products, indicating that producers have a choice of products they can use. Intralabial administration of reproductive hormones was equally effective as intramuscular injection for the induction of ovulation, and intralabial injection should be considered a viable administration site because it can eliminate injection site abscesses in carcasses at the time of meat harvest.

Introduction

Cow reproductive efficiency directly influences the profitability of every dairy farm. One obvious reason why reproduction impacts profitability is because cows must become pregnant and give birth in order to initiate lactation. Without lactation, farmers are unable to obtain product (milk) they can sell to generate income.

The US dairy cattle industry has made phenomenal strides in breeding cows with high genetic potential for milk production; however, one of the adverse consequences of this increased level of milk production has been a decline in

cow reproductive efficiency. Fortunately, the dairy industry has identified genetic traits (e.g., daughter pregnancy rate, sire conception rate, genomic haplotypes deleterious to reproduction) that are effective tools for dairy farmers to use to slowly reverse the decline in reproductive performance.

Another consequence of genetic selection for increased milk production in dairy cattle has been an increase in the proportion of cows with high metabolic rates. Although rapid metabolism is very helpful to make nutrients available for milk synthesis, it has likely led to a reduction in the duration of the period of estrus because the reproductive hormone responsible for expression of heat (estrogen) is also being metabolized more quickly. A reduction in the duration of estrus increases the likelihood that a dairy farmer fails to detect all cows in heat, and this negatively impacts reproductive efficiency.

To overcome potential difficulties with detection of estrus, protocols were developed to facilitate breeding of dairy cows without the need to detect heat. These protocols are commonly known as synchronization of ovulation protocols. Although protocols vary, synchronization of ovulation typically involves administration of two exogenous reproductive hormones - gonadotropin releasing hormone (GnRH) and prostaglandin F_{2α} (PGF). These hormones typically are administered intramuscularly.

One of the potential concerns associated with the intramuscular injection of reproductive hormones (as well as all other products) is the possible formation of abscesses at the site of injection. The dairy edition of the beef quality assurance audit conducted in 2007 reported that 11% of carcasses from dairy animals had visible injection site blemishes. These injection site blemishes must be removed before the meat enters the human food chain (and this removal is a cost passed to the consumer). If undetected, these carcass blemishes represent a potential food safety risk associated with intramuscular injections.

One potential method to circumvent injection site abscesses is to give injections of reproductive hormones in a part of the animal's body that is routinely discarded during the production of animal-derived foods. One such location is the external genitalia (labia) of the female.

The objectives of the study were to: 1) evaluate the effectiveness of intralabial versus intramuscular administration of reproductive hormones routinely used for synchronization of ovulation, and 2) compare the effectiveness of reproductive hormones produced by two different manufacturers (Lutalyse®/Factrel® [Zoetis] vs EstroPLAN®/GONAbreed® [Parnell]). Parnell products are relatively new (approved by FDA in March of 2013).

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Materials and Methods

This study was initiated in January of 2016 at the Iowa State University Dairy farm located near Ames, Iowa, USA. A total of 388 Holstein cows of varying parities were utilized in this research. Use of animals for this project was reviewed and approved by the Iowa State University Animal Care and Use Committee (IACUC).

Postpartum cows that passed the routine reproductive exam at approximately 40 days postpartum (range: 36-46 days) were enrolled in a Pre-Synch/OvSynch protocol as illustrated below:

Inject PGF2 α	M	T	W	Th	F	Sat	Sun
	M	T	W	Th	F	Sat	Sun
Inject PGF2 α	M	T	W	Th	F	Sat	Sun
	M	T	W	Th	F	Sat	Sun
Inject GnRH	M	T	W	Th	F	Sat	Sun
	M	T	W	Th	F	Sat	Sun
Inject PGF2 α	M	T	Inject GnRH	TAI	Th	F	Sun
	M	T	W	Th	F	Sat	Sun

Eligible cows were randomly assigned within parity to one of four treatment combinations in a 2 X 2 factorial treatment arrangement. Cows were treated with reproductive hormones manufactured by either Zoetis or Parnell, and cows received their designated reproductive hormone treatments either intramuscularly or intralabially.

Gonadotrophin releasing hormone (GnRH) products used for this study were: Factrel® (2 ml dose; 50 µg gonadorelin per ml; Zoetis product) or GONAbreed® (1 ml dose; 100 µg gonadorelin per ml; Parnell product).

Prostaglandin F2 α (PGF) products used for this study were: Lutalyse® (5 ml dose; 5 mg dinoprost tromethamine per ml; Zoetis product) or estroPLAN® (2 ml dose; 250 µg cloprostenol sodium per ml; Parnell product).

After receiving all reproductive hormone treatments, cows underwent timed artificial insemination (TAI). Eight days after TAI, left and right ovaries of all treated cows were examined via use of ultrasonography (EI Medical Imaging®, Ibex® EVO®, L6E linear transducer). Information was recorded on the number of corpora lutea as well as the presence of ovarian cysts.

Data were analyzed by analysis of variance using the PROC GLM procedure in SAS. It should be noted that not

all cows initially enrolled in this study remained on the study until the end of the reproductive hormone treatments. In some instances, cows that exhibited a strong heat after the second PGF injection of the pre-synch portion of the protocol were inseminated at that time (subsequently leading to their removal from the study).

Results and Discussion

Neither the site of reproductive hormone administration nor the product manufacturer affected the proportion of cows that ovulated, the proportion of cows that possessed two or more ovulations, or the proportion of cows with ovarian cysts. Overall, 90.0% of cows ovulated in response to the synchronization of ovulation protocol, 20.6% of cows exhibited multiple ovulations, and 8.8% of cows possessed ovarian cysts. Means (\pm std dev) by treatment combination are shown in Table 1.

Based on this preliminary analysis, both reproductive hormone manufacturers are marketing products that are effective in inducing ovulation in postpartum dairy cattle. Dairy farmers can choose either manufacturer of products and use them with equal confidence.

The main reason to investigate a site of reproductive hormone administration other than the muscle is because any intramuscular injection has the potential to create tissue damage and/or injection site abscesses in the animal's muscles. In theory, those same damaged muscles could subsequently enter the human food chain as a beef roast, steak or hamburger, and this would represent a potential food safety risk. Although federal inspectors at meat harvest facilities are extremely vigilant to prevent damaged product from entering the human food chain, a preferred solution to this potential problem is to prevent tissue damage altogether by reducing the number of intramuscular injections that food animals receive.

There was no difference in the effectiveness of the reproductive hormone products given in the muscle or the labia. Thus, the beef and dairy cattle industries could adopt the intralabial injection site and help reduce the number of carcass blemishes and reduce the amount of meat that is condemned (determined inedible) due to carcass abscess formation. Ultimately, this can increase the amount of beef available to consumers for consumption not only in the United States but also in export markets.

This alternate site of injection (in the labia) has been previously investigated (please see Youngs et al., 2004, Proc. Intl Cong Anim Reprod 1:60), and results of that previous also showed that intralabial and intramuscular injections were equally effective.

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Table 1. Reproductive response of postpartum dairy cows enrolled in a Pre-synch / OvSynch synchronization of ovulation protocol and treated with reproductive hormones marketed by different manufacturers and administered in the muscle or labia.

Product manufacturer	Injection site	Number of cows	Proportion of Cows		
			that ovulated	with multiple ovulations	with ovarian cysts
Parnell	muscle	96	0.896 ± 0.307	0.313 ± 1.079	0.052 ± 0.223
Parnell	labia	97	0.887 ± 0.319	0.134 ± 0.342	0.103 ± 0.306
Zoetis	muscle	100	0.900 ± 0.315	0.160 ± 0.368	0.120 ± 0.327
Zoetis	labia	95	0.916 ± 0.279	0.221 ± 0.417	0.074 ± 0.262