

## Significance

This study indicates that three of the animals initially thought to be persistently infected were instead acutely infected and IHC positive. Although sequence

homology was high between isolates from the animals, a subgroup of animals have a slightly different E2 profile. These PI animals provide an excellent opportunity to monitor virus evolution and immune response in animals infected with the same isolate.

# Effect of Two Commercially Available Multivalent Modified-Live Viral Vaccines on Milk Production of Holstein Dairy Cows

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## Introduction

Vaccination of lactating dairy cows is a common practice among US dairy herds. The objective of vaccination during lactation is to bolster immunity against common agents that may cause failure to conceive, fetal loss, or respiratory disease. The viruses commonly included in these vaccines are bovine viral diarrhea virus (BVDV), bovine herpes virus 1 (BHV-1), bovine respiratory syncytial virus (BRSV) and parainfluenza-3 virus (PI-3). The vaccines may contain inactivated virus or modified-live virus (*Compendium of Veterinary Products* 2004). In addition to the cost of vaccine and labor to administer the vaccine, producers should consider the cost of lost production when evaluating the economic benefits of vaccinating a lactating cow. Vaccination with an inactivated viral vaccine in combination with leptospiral bacterin produced a significant decrease in production compared to controls (Scott 2001). The effect of modified-live viral vaccines on milk production has not been reported. The objective of this study was to determine the effect of two commercially available multivalent modified-live viral vaccines on milk production of Holstein dairy cows.

## Materials and Methods

The study was conducted on a commercial dairy farm in the United States milking approximately 2,100 Holstein cows milked three times per day and producing approximately 70.4 lb (32 kg) milk/cow/day with 3.6% fat and 3.0% protein. The farm utilized a Westfalia parlor system with milk meters and electronic identification of animals in the milking stall, which allowed capture of daily milk weights. Cows were housed in sand-

bedded freestalls and divided among 17 pens based on a combination of age, stage of lactation and pregnancy status. Three hundred and two non-pregnant animals were enrolled over a 45 day period. Animals eligible to be enrolled were either less than 50 days-in-milk (DIM) and therefore not eligible to have been inseminated at the time of enrollment, or were diagnosed open by rectal palpation on the day of enrollment. At enrollment, cows were randomly assigned to one of three treatment groups using a prepared, randomly ordered treatment list. The treatment groups were control (C) which received 2 ml sterile saline intramuscularly, Arsenal (A) which received 2 ml of Arsenal 4.1 (Novartis) subcutaneously, and Bovishield (B) which received 2 ml of Bovishield Gold 5 (Pfizer) intramuscularly. A new needle was used for each injection and all injections were given in the neck. Vaccine was administered following the morning milking while cows were restrained in feed lane headlocks for routine herd management procedures. Ambient temperature at the time of vaccination ranged from 33.8 to 55.4°F (1 to 13°C). Vaccine was reconstituted just prior to use and any excess was discarded at the completion of the day's enrollment. Daily milk production was recorded for each cow from five days prior to vaccination until 14 days after vaccination. Of the 302 animals enrolled, 43 were eliminated from the data set prior to analysis. Health events or meter errors resulted in the removal of 14 animals (A, n=8; B, n=5; C n=1). All animals for week 6 (n=27) and two animals from week 7 were removed due to a failure to record pen location at the time of vaccination (A, n=9; B, n=10; C, n=10). Pre-vaccination (day -5 to 0) milk production results were analyzed by repeated measures analysis of variance. The model included the fixed effects of treatment group, day relative to vaccination, the interaction

between treatment group and day, parity, enrollment week, the random effect of pens and used a toeplitz covariance structure. The model also included DIM as a covariate. Post-vaccination (day 1 to 14) milk production results were analyzed by repeated measures analysis of variance. The model included the fixed effects of treatment group, day relative to vaccination, the interaction between treatment group and day, parity, enrollment week, the random effect of pens and used a toeplitz covariance structure. The model also included DIM and the pre-vaccination (days -5 to 0) average milk production as covariates. The interactions treatment group by DIM and treatment group by pre-vaccination milk production were initially included in the model but found to be non-significant and thus removed from the final model.

### Results

For the 259 animals included in the analysis (A, n=86; B, n=87; C, n=86), the mean number of lactations and DIM were 2.0, 140; 2.3, 128; 2.2, 132 for groups A, B, C, respectively. The distribution of parity, number enrolled per week and DIM were similar among groups. Pre-vaccination least standard means (LSM) milk production (A = 86.2 lb, 39.2 kg; B = 84 lb, 38.2 kg; C = 88 lb, 40.0 kg) was not significantly different between treatment groups ( $P=0.35$ ). The pre-vaccination milk production and the distribution of parity, DIM and number enrolled per week were similar among treatment groups, indicating that treatment group assignment was unbiased. The day pre-vaccination, week of enrollment and DIM significantly affected pre-vaccination milk production ( $P<0.01$ ). The significant effect of enrollment week on pre-vaccination milk production was due to an unequal distribution of DIM among enrollment weeks. Mean DIM for weeks 7 and 8 was 73 and 96, respectively, compared to mean DIM ranging from 161 to 172 for weeks 1 through 5. Due to logistics of the study farm, cows less than 100 DIM were not enrolled until the seventh week. Treatment group had a significant ( $P=0.035$ ) effect on post-vaccination LSM milk production (A = 81.6 lb, 37.1 kg; B = 80 lb, 36.4 kg; C = 82.5 lb, 37.5 kg). The

lack of significance of the group by DIM and group by pre-vaccination production interactions indicates the effects of DIM and pre-production level on post-vaccination milk production were similar for all treatment groups. The day post-vaccination significantly affected milk production ( $P<0.001$ ). The post-vaccination milk production of group A followed a similar pattern over the 14-day observation period as group C. Post-vaccination milk production was not significantly different between groups A and C on any day. However, milk production in group B was significantly ( $P<0.05$ ) lower than group C by 3.1, 3.1, 3.1, 3.5, 4.2 and 3.7 lb (1.4, 1.4, 1.4, 1.6, 1.9 and 1.7 kg) on days 4, 5, 8, 11, 12 and 13 post-vaccination, respectively. The 14-day observation period was insufficient to fully evaluate the effect of vaccination on milk production in group B as the effect may have persisted beyond the observation period. Week of enrollment and the covariates DIM and pre-vaccination average milk production significantly affected post-vaccination milk production ( $P<0.01$ ). The group by day post-vaccination interaction and parity were not significant ( $P>0.10$ ). As stated previously, the significant effect of enrollment week was due to an unequal distribution of DIM by enrollment week. The lack of significance of parity on milk production, both pre- and post-vaccination, was likely due to a study population comprised of 35.1% (91/259) first lactation cows and 35.5% (92/259) second lactation cows.

### Significance

In spite of great similarity in vaccine constituents, the effect of the two vaccines on milk production was significantly different when compared to the control group. The current experiment was not designed to explain the mechanism of the differences observed. However, it appears that seemingly subtle differences in vaccine composition significantly affect animals' physiologic response to the vaccine. The difference in effect on milk production may have economic significance to producers.