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In This Issue

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ag animal health *is devoted to the transfer of current, relevant information to food animal owners and veterinarians in the Pacific Northwest.*

From the Editor -This is the 53rd issue of *ag animal health*. In this issue, there are a couple of articles that revisit things we thought we knew: maternal versus colostrum replacer for calves, bull selection for the cow-calf herd, and Barber's Pole worm in sheep. Just like our last (Summer 2020) issue's revisit of serum total protein values to determine failure of transfer of passive immunity in calves, new research on old topics can show us brand new things or help us refine what we do on the farm.

Those of us in agriculture recognize the value of science in our daily work - we make more milk, get better average daily gain, reduce disease risks - all because some researcher somewhere cared about that issue and investigated it. However, many folks do not understand science the way we do and are confused by new research findings. We should reminder ourselves and others that science changes because we develop new ways to understand our world and how it works. For example, we did not have the bovine genome mapped until very recently but with new tools, it was accomplished. These new tools, and the science, change rapidly and seem to transform what we know almost daily. As a former colleague used to say, "biology is complicated" so that whenever we try to simplify science, we are liable to not get it exactly right, and what we think we know now could change tomorrow. We do the best we can with the tools and knowledge that we have at the moment.

"What gets us into trouble is not what we don't know. It's what we know for sure that just ain't so." ***Mark Twain***

Let Me Introduce You: New Ag Animal Faculty

The Ag Animal Team is happy to introduce two new faculty members. **Dr. Jennifer Sexton** started work in August as a food animal medicine internist. She comes to us from a residency program at the University of Tennessee and is a Purdue veterinary graduate. Her primary job is clinical work with all food animal species as well as clinical teaching.

Dr. Franco Leal-Yepes will be starting with the group this month. He completed a residency and PhD at Cornell University and was most recently working in their ambulatory service. Welcome to our new team-mates!

Dairy: What Happens If We Feed Maternal Colostrum Or Colostrum Replacer To Newborn Calves Beyond the First Day of Life?

By Dale A. Moore, WSU Extension Veterinarian

We all know the value of feeding 1 gallon of colostrum to newborns in the first few hours after birth. But what if calves were fed colostrum for a longer period? The cow naturally produces transition milk with more immunoglobulins and nutrients for a few more days after calving and some dairy farmers feed this transition milk to calves because of this.

Several years ago, we looked at feeding colostrum replacer (70 g per feeding) to calves from day 2 to 14 of life (Berge et al., 2009). We know that the "gut" is only "open" to the transfer of immunoglobulin (IgG) for the first 24 hours of life. The idea of our study was that the immunoglobulin antibodies in the replacer, added to the milk feeding, would provide some "local" gut immunity during the most vulnerable time in a calf's life, the first two weeks. We found that calves receiving supplemental colostrum replacer in their milk had less diarrhea and received fewer antimicrobial treatments than control and placebo-fed calves. The placebo-fed group had identical calories and protein levels as the colostrum-supplemented calves.

Three years ago, Chamorro and others (2017) conducted a similar study to ours but without a placebo group. They concluded that feeding 150 g of colostrum replacer in the milk feeding from day 2 to 14 reduced the chance of having abnormal feces by 6 times, the chance of abnormal respiration by about 2 times, and reduced the overall chance of receiving an antibiotic treatment by about 11 times compared to non-supplemented calves. Their study, and ours, indicate advantages of continued IgG ingestion by calves.

A very recent study (Kargar et al., 2020) was conducted a little differently. Instead of adding extra IgG to the daily milk allotment, they substituted some pasteurized colostrum for some of the milk volume. Calves got all milk (about 5 quarts per day), about 7% colostrum with milk, or about 14% colostrum with milk for the first 14 days of life. The investigators found that the calves fed a mix of colostrum and milk for 2 weeks gained more (particularly at the higher colostrum feeding rate), had fewer fever days, and less diarrhea and pneumonia.

Another recent study (Lopez et al., 2020) looked at feeding maternal colostrum or colostrum replacer for over 100 days after birth. The idea behind this study was to look at the "immunity gap" when passive immunity is fading and antibody production by the calf is just getting started. If fed colostrum, the IgG levels in the blood peak after the first day of life and then decrease slowly over time. The calf can then start to develop its own antibodies, but there might be a time when the antibody level is low, making the calf more vulnerable to disease. Some researchers have suggested that a colostrum-deprived calf develops their own antibodies faster than a calf that was fed adequate amounts of colostrum. The objective of the Lopez study was to compare IgG levels over time for calves fed high quality maternal colostrum, low-quality maternal colostrum plus replacer, or colostrum replacer with either 110 g or 150 g of IgG from birth to 112 days of age.

The results from the Lopez study showed that, as predicted, the calves receiving maternal colostrum had the highest serum IgG levels from day 1 (average about 26 mg/mL) all the way to about 35 days of age (average about 12 mg/mL)(Figure 1). The next highest serum IgG levels were in calves fed low quality maternal colostrum mixed with replacer and then those given 150 g of IgG in the colostrum replacer with those getting 110 g with the lowest serum IgG during the first month of life. After the lowest serum IgG was detected, (about 28 to 35 days of age for maternal colostrum-fed calves and 21 days for colostrum-replacer fed calves) serum IgG levels started to rise in all calves. The investigators concluded that calves fed less IgG at birth had lower IgG levels earlier than calves fed more IgG.

The Lopez group also concluded that calves fed a large mass of IgG had either a delay in self-production of antibodies or a reduced rate of production but still had a higher IgG concentration for a longer period of time compared to calves fed less. We could conclude that feeding more maternal colostrum at birth is best regardless of when the calf starts to produce its own antibodies. The only thing missing from this article were the health outcomes information for these 4 groups of calves. Having health outcomes would be most telling, although we have plenty of research to show that greater serum IgG concentrations after birth is associated with lower disease and mortality.

The evidence for the positive effects that feeding colostrum or additional IgG to neonatal calves after their initial consumption as a newborn is accumulating. Healthier calves that may gain more is the result. The thought that colostrum deprived calves may start their own antibody production earlier has some backing, but calves fed more colostrum over time maintain their serum immunoglobulin levels longer.

More is more when it comes to colostrum feeding. We could create healthier groups of calves with new strategies for utilizing colostrum or even transition milk. The next step is to try to understand the optimum level of feeding more colostrum or IgG beyond the first day.

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3. Kargar S, Roshan M, Ghoreishi SM, Akhlaghi et al. Extended colostrum feeding for 2 weeks improves growth performance and reduces susceptibility to diarrhea and pneumonia in neonatal Holstein dairy calves. J Dairy Sci. 2020;103:8130-8142. https://doi.org/10.3168/jds.2020-18355
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Dairy: Comparing Reproductive Success And Production In 3-breed Rotational Crossbreds of Montbéliarde, Viking Red, and Holstein Cows

By Craig McConnel, WSU Extension Veterinarian

Dairy cow fertility has substantial economic consequences. That we know. However, improving fertility without adversely impacting milk production can be challenging. A recent multi-year study (https://doi.org/10.3168/jds.2020-18196) within the *Journal of Dairy Science* explored the impact of crossbreeding on reproductive success.

The study was conducted over three generations utilizing a 3-breed rotation of Viking Red (VR), Montbéliarde (MO), and Holsteins (HO) that were compared against HO herdmates on commercial dairies in Minnesota. For the crossbred groups (VR X HO and MO X HO) the resulting 2-breed progeny were mated by AI to the third breed. Subsequently, the resulting 3-breed crossbreds were mated to HO bulls to create HO-sired crossbreds. Those HO-sired crossbreds were then mated to the breed of their maternal great-grandsire. For comparison, the foundation HO cows and their progeny were mated to HO bulls to maintain a continuous HO comparison group in each herd. All matings were with conventional, unsexed semen using proven AI bulls for all 3 breeds across all generations of the study. Fertility traits that were considered included first-service conception rate, overall conception rate, times bred, and days open.

Results from this large study indicated that the 2-breed crossbred cows were superior to HO herdmates for all four of the fertility traits across all lactations. In the second and third lactations the advantage of the 2-breed crossbred cows became even larger than the breed group difference during first lactation. When analyzed together, the two types of 3-breed crossbreds also had large

advantages over their HO herdmates for every fertility trait in each lactation number. Practically, this translated into fewer days open for the 2-breed crossbreds (12.0 fewer days open) and the 3-breed crossbreds (16.5 fewer days open) during their first 3 lactations. Although some dairy producers have expressed concern about the impact of MO on age at first calving, the results from this study suggested that crossbred heifers sired by VR, MO, or HO bulls should be managed identically to pure HO heifers with regard to age at first breeding and first calving.

Of course, reproductive results must be viewed considering milk production. This study found that during first lactation the 305-d fat, protein, and fat plus protein production (kg) was +2% higher for the 2-breed crossbreds compared with their HO herdmates. The difference was due to the higher fat and protein production (kg) of the MO × HO crossbreds. During the second and third lactations, the 2-breed crossbreds also had higher protein production (+1%) compared with their HO herdmates. The difference again was attributed to the higher protein production (kg) of the MO × HO crossbreds.

As you might expect, the fluid milk volume (kg) produced was lower for the VR × HO crossbreds compared with their HO herdmates during each of the first 3 lactations. However, the MO × HO crossbreds did not differ from their HO herdmates for fluid milk weight (kg) during any of the 3 lactations. Overall, the lower milk weight (kg) of the 2-breed crossbreds was offset by similar or higher fat plus protein production. This suggests that the 2-breed crossbreds can increase overall profitability compared with their HO herdmates for dairy producers whose milk is used for manufacturing. Of course, an economic analysis of production is incomplete without considering the feed required to produce milk solids, and feed efficiency should be a major consideration in any breeding plan.

Another recent study (https://doi.org/10.3168/jds.2018-15682) provides additional information regarding feed efficiency, income over feed cost, and residual feed intake when comparing 3-breed VR, MO and HO crossbreeds to HO herdmates. In that study, improved feed efficiency and income over feed cost for various generations of 3-breed crosses indicated that crossbred cows had an advantage for income over feed cost of +$0.51 per day compared with their HO herdmates. The bottom line is that rotational crossbreeding offers an opportunity to diversify dairy herds and potentially improve fertility and economic success.

Beef: Should You Select Beef Bulls For Calving Ease Or Calf Birthweight To Avoid Dystocias?

By Dale Moore, WSU Extension Veterinarian

More information on how ranchers can select bulls with the right traits for the cow-calf herd are available. Two such traits are calving ease and calf birthweight. But which trait is more appropriate if we want to reduce the chance for dystocia in the cow herd? We know that the bigger the calf, the greater the chance for the cow or heifer to have a dystocia. We also know that dystocia is a bad deal all around. We might lose the cow, lose the calf, or have trouble breeding the cow back because of the damage done. We also have labor costs involved in watching and assisting calvings. What is the best strategy when it comes to choosing bulls for the herd?

A recent paper in the *Journal of Animal Science* (Saad et al., 2020) discussed the difference between selection of Simmental bulls based on calving ease or selection based on low calf birthweight traits. The investigators looked at records from almost 100,000 animals that had measurements for them all the way to yearling weights. The authors looked at many different

traits that could be linked with calving ease or birth weight traits and what would happen (on a population level) if we selected based on one or the other.

First, measurement for birth weight is pretty easy. But, how is calving ease measured? Calving ease is related to the calving ease scoring system where 1 = No assistance; 2 = Some assistance; 3 = Mechanical assistance; and 4 = C-section. A score of 5 = Abnormal delivery. To gather data on calving ease to use for establishing bull Expected Progeny Differences (EPDs) requires that some specific-breed ranchers keep track of it and the data are collected by the breed associations.

Calving ease is related to birth weight. However, other investigators have noted that if you select based on birth weight only, you run the risk of producing heifers that are smaller and may have smaller pelvic areas, putting them at risk for dystocia. The recent report found that selection for low birth weight will improve calving ease but not as effectively as using the calving ease trait. Selection based on birth weight is at the expense of both weaning weights and yearling weights. The selection for calving ease produced heavier calves at weaning and as yearlings with a lower incidence of dystocia than using selection based on low birth weight in the Simmental breed.

Profitability in beef herds requires that cows get serviced, conceive, carry a calf to term, and raise a fast-growing calf to weaning. Dystocia can affect many of these steps to getting a calf to sale. In addition, selection for animals based on just one particular trait might have effects on overall performance of those animals to weaning as well as in the feedyard.

Reference

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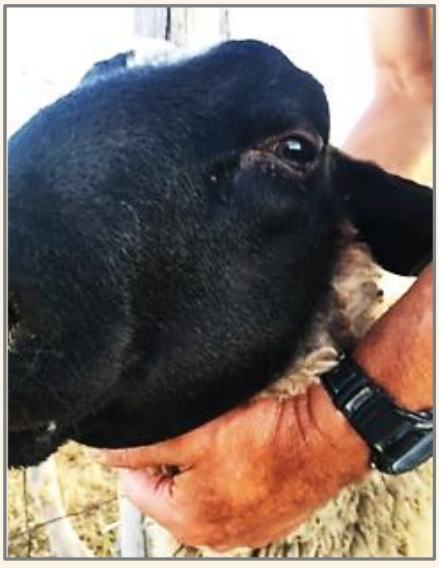
Sheep: Barber's Pole Worm Reminder

By Craig McConnel, WSU Extension Veterinarian

Haemonchus contortus is the scientific name for an internal parasitic nematode of sheep commonly known as the Barber's pole worm or wire worm. This worm resides in the abomasum and can lead to acute anemia in lambs, bottle jaw, chronic weight loss, extreme weakness, shortness of breath, or death in adults. Feces typically remain well formed although diarrhea may be present if there is a heavy infestation with other nematodes. Adult Barber's pole worms each can ingest 0.05 mL of blood per day and infection can lead to loss of red blood cells and protein, destruction of enterocytes and gland cells, inflammatory changes in the gut wall, and a metabolic "cost" of repairing gut wall damage. There also can be hidden costs due to subclinical cases with suboptimal productivity causing reduced meat, milk, wool, and/or offspring. Diagnosis can be based on fecal egg flotation or identification of worms within the abomasum at necropsy. Although numerous treatment possibilities exist, drug resistance often develops.



Bottle Jaw –
Photo Courtesy of Dr. Konetchy

Ultimately, parasitism is a medical condition of the population that may manifest as disease in individuals. Clinical cases demonstrating signs of disease are the tip of the iceberg with subclinical cases making up the bulk of infected animals. However, some level of parasitism in the animal population is inevitable, and arguably healthy. Disease is a result of overwhelming numbers of parasites or weakened hosts due to other diseases or stressors.

Factors that determine the severity of a nematode burden include stocking rate (animals per acre) with the risk roughly equal to: (number of animals / area) * time. Grazing behavior, separation of feed from feces, nutrition, anthelmintic resistance, age, and immunity all impact infection severity as well. Grouped young stock are most often affected, although geriatric animals are also at greater risk than healthy adults. Importantly, environmental conditions help dictate infection pressure.

The infective stage of the larval life cycle is encased in a sheath or "cuticle" and is dependent on nutrients and water within that cuticle. Consequently, these larvae survive well in moist, moderate temperature environments but have poor survival in hot, dry areas. This is vital to management given that once parasites become established in a population, 90% of the parasite biomass is in the environment and only 10% is in the animals! That means that pasture management is absolutely necessary for effective control against gastrointestinal parasites such as Barber's pole worms.

Cornerstones of environmental management include reducing the larval numbers, reducing the stocking rate, keeping food and feces separate, and moving "clean animals onto clean pastures". Mowing pastures is one method to reduce larval numbers by allowing sun exposure and drying at the ground level. Clippings must be removed for this to be effective, although they can be harvested as hay for other species. "Resting" a pasture without animals can also reduce larval numbers with a recommended 3-month rest in summer (2 months if hot and dry), or 6 months in winter. Larval numbers also can be reduced by burning pastures, grazing by alternate species (horses, cattle), or using pasture vacuums (yes, they are a real thing!).

Obviously, the stocking rate can be reduced by increasing the amount of land grazed or decreasing the number of animals on the current land. Separating feed from feces can be challenging on small farms that have acquired too many animals for a given pasture size. In that situation the solution might be to create a dry lot and feed hay and grain from feeders. Finally, placing clean animals onto clean pastures requires rotational grazing. Deworm the flock and then move them to a low-parasite pasture or crop residue pasture. "Unclean" pastures may be used for adult sheep (rams, gestating ewes), particularly during the winter when the cold will cause a slow rate of new infective larval development from eggs.

For more information on Barber's pole worm management in particular check out this link: https://www.wormx.info/part2. For information regarding the development of a vaccine for Barber's pole worm (currently unavailable in the US) check out this link: https://www.wormx.info/single-post/2019/08/20/A-Vaccine-for-Barber-Pole-Worm. And for an all around excellent source of information regarding small ruminant parasite control, check out the American Consortium for Small Ruminant Parasite Control: https://www.wormx.info/.

Swine: Preventing PRRS From (Re)Entering Or Spreading In Washington State

By Dale Moore, WSU Extension Veterinarian

If you were paying attention to anything other than COVID news recently, and care about pigs, you know about the illegally imported pigs into Washington State. These pigs were coming from Iowa and headed to a Montana slaughter facility. They were diverted by someone in Idaho and sold on Craig's list into Washington State and Idaho. They had "slaughter only" health certificates that allowed them interstate transport but only to Montana. So, the saga begins.

Someone who purchased some of these animals had a pregnant sow that died. They did the right thing and had the sow necropsied by our own WADDL where she was found to be infected with both PRRS virus and circovirus 2, neither of which has been seen in Washington before. Other pigs in the group were sick as well.

PRRS stands for Porcine Reproductive and Respiratory Syndrome, caused by a virus resulting in reproductive impairment or failure in breeding animals and respiratory disease in pigs of any age. The virus is unusual because some pigs can become long-term carriers (up to 200 days). Clinical presentations in the swine herd will vary because of virus strain variations and other factors. But we do know that PRRS can be tough to get rid of. Because of the clinical problems it causes and the potential for carriers, keeping the virus from getting into a swine herd is key.

It goes without saying that "buyer beware". If it sounds too good to be true, it probably is and there are still folks out there that will take advantage of certain situations. From some work we did in California, **the single most important entry point for diseases onto a farm is through purchased animals**. As an exercise, consider all the pigs that may come on to a farm. Newly purchased sows (as in this case), new boars, replacement gilts, and 4H or show animals that may come and go from fairs back to the farm are all potential "trojan" pigs.

An accurate diagnosis is critical. If an animal dies unexpectedly or from something unknown, it is prudent to get a necropsy. A veterinarian and WADDL can help determine the samples to take and submit. Having a diagnosis can inform what the next steps are.

Having a biosecurity plan in place will prevent diseases like PRRS and other diseases onto the farm. For swine-specific biosecurity checklists (both indoor and outdoor-raised pigs) see the SecurePork site on biosecurity.

Poultry: 2020 Poultry Institute!

The 2020 Poultry Institute will be a web-based event held on Tuesday, October 27th, 2020 from 8 AM to 4 PM. This conference is intended for veterinarians, veterinary technicians, and producers. We have an exciting group of speakers lined up and a full schedule should be available shortly. Topics will include the North and South Carolina low pathogenic and high pathogenic avian influenza outbreak and the California velogenic Newcastle Disease outbreak, among others.

To facilitate the web-based format, the Avian Health and Food Safety Laboratory is collaborating with Washington State University's Vet Med Extension Team. Please **register** at the following link: https://apps.vetmed.wsu.edu/CVME/PoultryInstitute2020/ The cost is just $15 per person. Continuing education credit has been approved for veterinarians and veterinary technicians.

Poultry: Intestinal Coccidiosis And Management Strategies

By Laura Chen, Branch Chief, WADDL-AHFSL

Intestinal coccidiosis is relatively common in chickens and a thorough understanding of the condition is relevant to most types of production systems. It is caused by protozoal parasites in the genus *Eimeria*, with the clinically relevant species including *E. acervulina, E. maxima, E. necatrix,* and *E. tenella.* These parasites are host specific to chickens and even beyond that, tend to infect specific segments of the intestinal tract. *E. acervulina* primarily infects the front half of the small intestine; *E. maxima* and *E. necatrix* primarily infect the jejunum; and *E. tenella* nearly exclusively infects the paired ceca.

Clinical signs of coccidiosis primarily occur in young chickens, though not exclusively. They result from direct damage to the intestinal tract as the organisms infect, replicate, and complete lifecycles within the lining of the intestinal tract or the mucosal epithelium. The severity of symptoms can range from subclinical characterized by subtle declines in body weight and growth rate to more severe characterized by mucoid, watery, or bloody droppings; lethargy; fluffed stance; dehydration; anemia; and death. Mortality spikes tend to be most significant with secondary necrotic enteritis caused by *Clostridium perfringens*, a not uncommon sequela.

Like mammalian species, transmission of *Eimeria* spp. is by the fecal-oral route, with sporulation in the environment a necessary step for the formation of infective oocysts. Sporulation requires approximately 24 to 48 hours in an environment with optimal conditions, which include moderate temperatures (80 to 90°F), high litter moisture (50 – 75%), and adequate oxygen supply.

Diagnosis of coccidiosis is relatively straightforward by fecal floatation. Interpretation of the significance of the coccidial burden can be a little more complicated. In the absence of clinical symptoms, low numbers of coccidial organisms identified by fecal floatation do not automatically warrant treatment and may in fact help the chicken to develop immunity. To the other extreme, marked numbers of coccidial organisms along with gastrointestinal symptoms likely warrant treatment. In the middle is a spectrum that probably necessitates addition questions to obtain a more complete clinical picture.

Necropsy examination with intestinal mucosal scrapings and microscopic examination is also a great diagnostic test for coccidiosis and may provide additional insight into the pathology associated with the pathogen. Of course, this may not be agreeable to smaller backyard chicken flocks wherein the chickens truly are pets.

When clinical coccidiosis is confirmed, treatment of the flock with amprolium or a sulfa drug is likely appropriate. Because chickens are considered a food producing species, labeled instructions should be followed for both administration and withdrawal times. If there are any questions or concerns about either, the Food Animal Residue Avoidance Databank is a great resource and can provide recommendations.

Prevention is preferable to treatment. Coccidiosis vaccination is used with good success in the commercial poultry industry but it is not as readily available to backyard chicken owners and may not be a good option depending on the housing system. Biosecurity is always a great start because it can minimize introduction of a wide variety of diseases into a flock. Reduction of litter moisture can help reduce coccidial sporulation and consequently the development of infective oocysts. Taking it a step further, rotating to a fresh housing area can help reduce exposure to coccidial organisms present in the manure. Medicated feed may also be a good option to help protect chicks during the early life period while the immune system develops.

Chicken in dorsal recumbency with the viscera exposed. Segmentally, the ceca are distended and there is transmural wall hemorrhage visible from the serosal surface. On further dissection, the cecal lumina were filled by caseous cores and there was mucosal ulceration. Histologically, this typhlitis was confirmed to be due to *E. tenella*.

WSU Ag Animal Faculty Research Updates

(1) Spencer J, Konetchy D*, Ahmadzadeh A. Influences of non-steroidal anti-inflammatory drugs on cattle reproductive performance. Applied Animal Science. 2020; 36 (3): 397-406. https://doi.org/10.15232/aas.2019-01969.

Purpose -- Reproductive efficiency is an important contributor to a dairy farm's profitability; however, there are many factors that influence reproductive success, including, but not limited to, embryonic loss. This review summarizes research findings related to the use of prostaglandin F2α (PGF2α) inhibitors to improve fertility in cattle.

Sources -- Peered-reviewed literature and conference proceedings were reviewed in this article.

Synthesis -- Approximately one-third of total embryonic loss occurs between d 8 and 27 after fertilization. Because of a large incidence of early embryonic loss in cattle, researchers have been searching for strategies to reduce the risk of embryonic loss. Provided that the embryonic loss, in part, is related to untimely secretion of PGF2α and premature luteolysis, any management strategy to delay the synthesis and secretion of PGF2α during the time of maternal recognition of pregnancy may reduce the occurrence of early embryonic loss. Consequently, researchers have investigated the potential use of PGF2α inhibitors to address the risk of embryonic loss.

Conclusions and Applications -- Non-steroidal anti-inflammatory drugs (NSAID) are known inhibitors of PGF2α. In cattle, application of NSAID, as a reproductive tool, to improve fertility has been investigated extensively using a variety of NSAID, timing of administration, and breeding techniques. **It seems that many NSAID do not consistently improve reproductive efficiency in cattle, and perhaps, treating all cows with an NSAID after calving is unlikely to be economically advantageous. Nevertheless, the research supports the fact that NSAID, in the form of flunixin meglumine or ibuprofen, consistently improved fertility in cattle, when administered at the time of embryo transfer.**

***Dr. Konetchy, at the University of Idaho, is part of our WSU ag animal team!**

(2) Kasimanickam R, Jorgensen-Muga K, Beumeler J, Ratzburg K, Kapi A, Kasimanickam V, Kastelic J. Estrous response and pregnancy percentages following use of a progesterone-based, split-time estrous synchronization treatment regimens in beef heifers. Anim Repro Sci. 2020; 21;221:106544. doi: 10.1016/j.anireprosci.2020.106544
Mean estrous response rate (%ERR) and pregnancy/AI percentages (%P/AI) were determined after imposing split-time AI (STAI) and fixed time AI (FTAI) following 14-d controlled internal drug release (CIDR)+PGF2α or 5-d Select Synch + CIDR regimens. In Experiment 1, 1152 heifers (five locations) were randomly assigned to 14- or 5-d and to 54 + 74- or 64 + 84-h STAI treatment combinations. Estrous detection patches were affixed at PGF2α administration (19 day after- and on day 5 at- CIDR removal for 14- and 5-d regimens, respectively), assessed at 54- or 64-h and again at 74- or 84-h after PGF2α. Heifers determined to be in estrus at respective times were inseminated and non-estrous heifers at 74- or 84-h were given GnRH and inseminated concomitantly. The %ERR between 54 + 74- and 64 + 84-h STAI combinations differed (73.2 % and 78.8 %, respectively; $P < 0.05$), but %P/AI did not. In Experiment 2, 2014 heifers (eight locations) were randomly assigned to 14- or 5-d regimens and were inseminated split-time (64+84-h combination, similar to Experiment 1) or at fixed time (72- or 56-h after PGF2α for 14- or 5-d regimens, respectively). There were differences ($P < 0.01$) between STAI and FTAI treatments for %ERR (81.3 % and 64.4 %) and %P/AI (61.2 % and 55.4 %). Estrous synchronization regimen by AI treatment interaction ($P < 0.05$) showed that the %ERR were 79.8 %, 82.6 %, 66.2 % and 62.8 % and the %P/AI were 58.9 %, 63.4 %, 56.5 % and 56.5 % (for 14-d/STAI, 5-d/STAI, 14-d/FTAI and 5-d/FTAI, respectively). In conclusion, the 5-d CIDR with 64+84-h STAI combination was the most effective because of the greater %P/AI when this regimen was imposed.

(3) **Kasimanickam RK, Kasimanickam VR. IFNT, ISGs, PPARs, RXRs and MUC1 in day 16 embryo and endometrium of repeat-breeder dairy cows, with or without subclinical endometritis. Theriogenology** 2020;158:39-49.
Interferon-τ (IFNT), IFN stimulated genes (ISG15, CTSL1, RSAD2, SLC2A1, CXCL10, and SLC27A6), Peroxisome proliferator activated receptors (PPARA, D, and G), Retinoic acid receptors (RXRA, B, and G), and Mucin-1 (MUC1) play decisive roles in embryo elongation. The objective was to elucidate expressions of these genes in day 16 embryo [tubular (n = 4) vs. filamentous (n = 4)] and corresponding endometrium [without (n = 4) vs. with subclinical endometritis (SCE; n = 4)] of repeat breeder Holstein cows (2 × 2 factorial design). Results showed that the mRNA abundances (except PPARA and RXRB) were greater ($P < 0.05$) in filamentous embryo and endometrium without SCE compared with tubular embryo and endometrium with SCE, respectively. Overall, the mRNA abundances (except RSAD2, PPARA and RXRA) in filamentous embryo and corresponding endometrium of cows without SCE were greater ($P < 0.05$) than tubular embryo and corresponding endometrium of cows with SCE. Proteins IFNT, ISGs, PPARs and RXRs (except RXRB) were greater ($P < 0.05$) and protein MUC1 was lower ($P < 0.01$) in filamentous embryo and corresponding endometrium of cows without SCE compared to tubular embryo and corresponding endometrium of cows with SCE. On pairwise comparison, mRNA and protein abundances of MUC1 significantly differed between tubular embryo in uterus with or without SCE, and corresponding endometrium with or without SCE ($P < 0.05$). In conclusion, the mRNA and protein abundances of IFNT, ISG15, CXCL10, PPARG and MUC1 differed among filamentous and tubular conceptuses, and endometrium with or without SCE of repeat breeder cows on Day 16, indicating that these genes and their downstream signaling cascades play important roles in embryo elongation. Perhaps, interruptions in crosstalk between endometrium and conceptus impaired conceptus elongation in repeat breeder cows with SCE. In addition to disrupted signaling, the tubular conceptus (compared to filamentous conceptus) was unable to downregulate MUC1 (anti-adhesive glycocalyx) in repeat breeder cows with or without SCE, resulting in early embryonic demise.

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