Proceedings of the 6th Annual I-29 Dairy Conference

Sustaining Our Dairy Families, Farms and Rural Communities: A Focus on Animal Well-being

February 9-10, 2011
Best Western Ramkota Hotel
Sioux Falls, South Dakota
The 6th Annual I-29 Dairy Conference was coordinated by the following educational institutions and their Extension Services:

Iowa State University, North Dakota State University, South Dakota State University, University of Minnesota, and University of Nebraska

and

Midwest Dairy Association
Southwest Minnesota Dairy Profit Group

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Speakers

Temple Grandin

Temple Grandin, a professor at Colorado State University, has done extensive work on the design of livestock-handling facilities and has published several hundred industry publications, book chapters and technical papers on animal handling. She also has authored several books, including “Thinking in Pictures”, “Emergence Labeled Autistic,” “Animals Make Us Human,” “Improving Animal Welfare: A Practical Approach,” “The Way I See It” and “Animals in Translation,” which was a New York Times best-seller.

Grandin obtained her B.A. at Franklin Pierce College in 1970 and then was employed as a livestock editor for the Arizona Farmer Ranchman and also worked for Corral Industries on equipment design. In 1975, she earned her M.S. in animal science at Arizona State University. Grandin was awarded her Ph.D. in animal science from the University of Illinois in 1989.

Grandin has been recognized by humane groups, and HBO recently premiered a movie about her early life and career with the livestock industry. She was honored in Time magazine’s 2010 “The 100 Most Influential People in the World.”

Grandin’s photo courtesy of Angus Bremner, Bremner Photo, Edinburgh, UK.

Scott Higgins

Scott Higgins is president and chief executive officer of the American Dairy Association-Mideast, based in Columbus, Ohio.

Higgins also is CEO of the Ohio Dairy Producers Association and Ohio Dairy Industry Forum and is a member of the senior management team at Dairy Management Inc. with the CEOs of 18 other state and regional organizations.

Higgins grew up on a dairy farm in Ohio and joined ADA-Mideast upon graduation from The Ohio State University in 1984 with a bachelor’s degree in agricultural economics. From 1994 to 1996, he partnered with Milk Marketing Inc. (now Dairy Farmers of America) to create and introduce Moo Kooler, the first single-serve flavored milk line designed specifically for kids in a 12-ounce bottle.

Scott and his wife Lisa have four children, Nicholas, Candace, Elisa and Travis. They reside in Johnstown, Ohio.

Jim Paulson

Jim Paulson is a dairy educator with the University of Minnesota Extension Service in Hutchinson.

Paulson has statewide dairy education responsibilities. He specializes in dairy nutrition and forages and has experience as a dairy consultant as well as a dairy producer.
Paulson grew up on his family’s diversified livestock farm in southeastern Minnesota. He received his undergraduate degree and a master’s degree in dairy science, with a minor in agronomy, from the University of Minnesota.

**Crystal Powers**

Crystal Powers is an Extension engineer in Biological Systems Engineering at the University of Nebraska-Lincoln.

Powers’ research and Extension efforts involve the impact of livestock on agricultural ecosystems. She has been involved in the development of the Nebraska Odor Footprint Tool, air quality technology demonstrations, and vegetated treatments systems.

Powers received her undergraduate degree in biological systems engineering from the University of Nebraska-Lincoln and her master’s degree in agricultural and biological engineering from Cornell University.

**Jan Shearer**

Jan Shearer is a professor and the Extension veterinarian at Iowa State University. His primary research and Extension interests are cattle lameness and welfare issues.

Shearer received his doctor of veterinary medicine degree from The Ohio State University in 1975. He was an associate veterinarian at the Orrville Veterinary Clinic in north-central Ohio for 4½ years before returning to Ohio State to pursue graduate studies in nutrition. He later became an assistant professor in the Department of Veterinary Preventive Medicine at Ohio State. In 1982, he relocated to the University of Florida as a professor and Extension dairy veterinarian at the College of Veterinary Medicine. Shearer served the University of Florida for 27 years before accepting his current position.

Shearer is immediate past chair of the American Association of Bovine Practitioners’ Animal Welfare Committee, a member of the American Veterinary Medical Association’s Panel on Euthanasia and chair of its Food Animal Working Group, and a member of the Professional Animal Auditor Certification Organization’s board of directors. He also serves on the Organizing Committee and board of directors of the American College of Animal Welfare.

**Lon Whitlow**

Lon Whitlow is professor emeritus in the Department of Animal Science at North Carolina State University. Whitlow’s degrees are from the University of Kentucky (B.S.), University of Florida (M.S.), and the University of Wisconsin (Ph.D.).

Whitlow served as dairy nutrition extension specialist, extension leader for the Department of Animal Science and coordinator of dairy research at the North Carolina Piedmont Research Station.
# Program Agenda

**Wednesday, February 9**                                    | **Room**
---|---
3:30-9:00 pm *Registration* ................................................................. *East Lobby*
4:00 pm *Media Event with Temple Grandin* ......................................................... *Jefferson*
SD-MDA Producers Annual District Meeting ............................................. *Washington*
5:00 pm *Exhibits Open* .............................................................................. *East Lobby Hallway*
5:30 pm *Social* ............................................................................................. *Washington*
6:00 pm *Dinner* ............................................................................................. *Washington*

**KEYNOTE PRESENTATION** *(open to the public)*
7:00 pm *How to Implement Animal Well-being Auditing Programs* .................. *Jefferson*
- Temple Grandin, Colorado State University  
  Animal well-being is a concerning issue in the livestock industry. Find out how the general public views this and agriculture in general.

8:15 pm *Recess*

**Thursday, February 10**

7:30 am-2:00 pm *Registration* ................................................................. *East Lobby Hallway*
8:00 am *Breakfast / Meet the Vendors*

**OPENING SESSION**
10:00 am *How Do You Define Sustainability?* .............................................. *Jefferson*
  - Jim Paulson, University of Minnesota Extension  
  Sustainability has been described as a “wicked problem”; whatever that is. In this presentation we will cover the debate about sustainability and what it might mean to you.

10:45 am *Reducing Fear Improves Milk Production* ........................................ *Jefferson*
  - Temple Grandin, Colorado State University  
  What is effective stockmanship? Find out why stockmanship is important and learn how cows with large flight zones will be less productive.

12:00 pm *Lunch* ............................................................................................. *Washington*
12:30 pm *Virtual World Tour of Sustainable Dairy Operations* ...................... *Washington*
  Come along with us as we visit dairies from Holland, Belgium, Spain, and more. See how fellow dairy owners operate their dairy.
GENERAL SESSION

1:15 pm  **Livestock Care Issues: Past, Present and Future**  ...............................................  Jefferson

-Scott Higgins, Ohio Dairy Producers Association

*Scott will provide some background into how Ohio’s livestock industry has addressed animal well-being over the past 20 years and provide insights into why and how the Ohio Livestock Care Standards Board was formed in 2009. He will also provide insights into the agreement that was reached between Ohio’s unified agricultural organizations and HSUS to halt HSUS’s additional ballot initiative in 2010 and allows the OLCSB to complete its mission as approved by Ohioans in 2009.*

2:00 pm  **Break**

BREAKOUT SESSIONS (pick two of three choices)

2:30-3:15 pm  **Session One**

- **Lameness: Effects on Performance, Profit, and Welfare**  ..................................................... Jefferson
  -Jan Shearer, Iowa State University

*From a welfare perspective, lameness ranks among the most important of diseases affecting dairy cattle because it frequently goes undetected until the condition is quite advanced. Prompt identification and treatment are key to reducing losses and minimizing the impact on animal welfare.*

- **Dairy Carbon Footprints: A Tool for Your Farm**  ................................................................. Lincoln
  -Crystal Powers, University of Nebraska

*Improving farm efficiencies and manure management also reduces your carbon footprint. We will explore a simple Carbon Footprint tool that you can use to evaluate management and technology options for your operation.*

- **Mold and Mycotoxins in Your Dairy Feeds**  ................................................................. Roosevelt
  -Lon Whitlow, North Carolina State University

*The wet grain crop season and unusually warm temperatures have led to increased incidence, effects, and management of molds and mycotoxins in dairy feeds. Learn the significance of mycotoxins to dairy cattle production and well-being and some methods of prevention and treatment.*
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The University of Minnesota’s Department of Animal Science is recognized nationally and internationally for its research, teaching and extension programs in dairy. This year, we have over 400 undergraduate students in Animal Science with about 20% of the students having a dairy interest or emphasis.

The Gopher Dairy Club is the largest club at the University of Minnesota with more than 100 students who get together for fellowship and fun, and to talk dairy. Students who graduate with a degree in Animal Science are finding excellent positions in many areas of our livestock industry, or furthering their education in veterinary school or graduate school.

Our dairy research is focused on genetics, nutrition and management of cows and calves, milk quality, and animal welfare and behavior. Dairy research studies are conducted within the University on three lactating dairy herds across the state, including a 140-cow herd on the St. Paul Campus. An 800-head calf and heifer facility for research is located at Waseca, MN. These facilities provide opportunities to conduct a wide range of dairy studies including our new organic and grazing initiative at Morris. For information on research and teaching programs related to dairy, please visit our website at www.anisci.umn.edu.

The statewide dairy extension program is a full service program providing technical information and educational programs in many areas of dairy science. The program is served by faculty on campus, at Research and Outreach Centers, and at three regional centers in the state. A calendar of dairy programs and educational opportunities along with a large resource library of information on many dairy subjects and troubleshooting dairy problems can be found at www.extension.umn.edu/dairy/.

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Department of Animal Science
University of Nebraska-Lincoln

PROGRAM DEFINITION

Hands-on...challenging...rewarding: The University of Nebraska-Lincoln Animal Science Department offers all this and more as students prepare for careers related in animal biology and industry. The management, well being and safe use of animals for food, fiber, and recreation are all components of this science-based profession.

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- Block and Bridle Club has received national recognition.
- Students have received national recognition through International Livestock Congress, National Cattlemen's Beef Association, American Meat Science Association, National Block and Bridle Club; All-American Judging Teams and other organizations

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- Animal birthing facilities, horse stalls, an indoor arena and classrooms equipped to hold animals and people, allow students hands-on experiences with many types of livestock.
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FACULTY

Faculty are among the nation's leading professionals in teaching, research, and extension. With 38 faculty members, the department has one of the lowest student-to-teacher ratios in the region. Faculty serve as student advisors and who meet regularly with students outside the classroom.

For Information Contact: Stacey Agnew, Animal Science Admissions Coordinator, Phone: (402)472-0204, Email: sagnew2@unl.edu
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Over the past year, the MDI Dairy Profit Teams and the producers they serve, have shared their stories of how a producer, along with a diagnostic team, can achieve success by working together. The Hoffmans are another example of how the program benefits the dairy producer. Don was recommended to the program by Rich Schmitz, a veterinarian with the New Ulm Regional Vet Center.

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3. What were the biggest benefits you gained from participating in the program?
   “Every meeting the group would discuss two to three main topics. The team would ID issues that were going wrong on the farm. They would put together a plan to fix the problem and we would execute it. The team would follow up on those topics at the next meeting. This follow up forces you to accomplish your goals. It organizes your topics and makes you focus and get something done.

Initially, we didn’t accomplish a lot, but by the second year, we were seeing results. Herd health improved dramatically. We also gained in feeding. The cows are on a better diet now. Recent topics include focusing on water quality issues and putting in a water treatment system. We are also looking into putting in a pasteurizer for our waste milk, and figuring out if we can make it work here. The team approach was helpful in keeping my banker informed. He gets to see first-hand what’s going on here – what’s good and what’s not so good, so he can see where to invest. It helps especially when times get tough. I guess I was surprised about the group’s ability to get things done and the follow-up by the members involved. This group of people is very efficient and get things done. I think it’s an absolutely fantastic program. I would encourage anybody, big, small or in between, to get involved with this program. I look forward to the meetings weeks in advance. I’m getting more and more out of it every time.”
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How to Implement Animal Well-being Auditing Programs

Temple Grandin
Professor
Department of Animal Science
Colorado State University, Fort Collins

NOTES
How Do You Define Sustainability?

Jim Paulson
Extension Educator
University of Minnesota Extension
Hutchinson, MN

Sustainable Families ➔ Sustainable Farms

Sustainable Farms ➔ Sustainable Work Force

Sustainable Work Force ➔ Sustainable Communities

Sustainability is a popular buzzword today. But what does sustainability mean to you and your dairy business?

Sustainability, by simple definition, is the ability to continue, endure or maintain. Ask yourself: “Is there any part of my business or anything that we are doing today that the next generation will not be able to do?” You now may be thinking, “We are a fourth-generation farm; we must be sustainable.” Or, “I’m making money, so I must be sustainable.” However, sustainability has several aspects that lead to much confusion about its meaning.

Sustainability is hard to define because it often involves choices that are not simply black or white, but the impact may be better or worse for your situation. Worse yet, sometimes we don’t even know a problem exists, or what the problem is, making the pending situation very difficult to solve.

I might suggest thinking of sustainability as illustrated by the three circles in the figure below. Three circles of possible consideration are economics, environment and social. The common area that exists between any two circles is the interaction between these two areas of concern. However, this is a three-legged stool. For the greatest stability, each leg has to be equal in length, or in this case, in contribution to its support of the whole system.

Figure 1. Three legs of business sustainability.
Economic - Now, let’s redefine the circled words with people, planet and profit. The first priority for any business model is to survive. Ultimately, to survive, a business has to be profitable in the long term. Without generating a profit, no dairy operation can sustain itself very long without an outside infusion of capital. This is the very situation that has been plaguing the dairy industry the last couple of years. With the milk price below cost of production, in only a matter of time, the dairy farm is no longer profitable and, therefore, cannot be sustainable. Survival comes down to net worth, the amount of equity and the ability to borrow money. We may not have thought about it this way, but expansion is sustainability. If we want the farm to continue on to the next generation, we need to grow to generate the income necessary to sustain the next generation. Very few farms are the same size as they were two generations ago.

Environmental - The future of our planet has become as important as profit for sustainability because of its strategic role in increasing productivity. This must be done with finite resources while meeting new and tighter regulations. In the past couple of years, the planet portion of the sustainability equation has become the main focus for much of the world. For example, the Climate Change Conference focused on the impact of climate change, determining greenhouse gases and the challenges of feeding our growing population.

We hear so much about it, but just what are greenhouse gases (GHG)? A GHG is defined as a gas that holds heat in the atmosphere, thus contributing to the potential for global warming. Examples include carbon dioxide (CO$_2$), methane (CH$_4$) and nitrous oxide (N$_2$O). The term carbon footprint is the amount of CO$_2$ or CO$_2$-equivalent produced by some activity. Methane has 21 times the heat-holding capacity of carbon dioxide, and nitrous oxide has 298 times the heat-holding capacity and potential to contribute to global warming. This is important to the animal industry because ruminant animals are the most scrutinized because they belch methane while digesting their feed. That is why there is interest in decomposing manure; it generates methane, which then can be captured in digesters. Unfortunately, most of it is lost during the process.

However, incorporating manure into the soil following land application reduces nitrous oxide emissions, as well as reducing odor and potential runoff. Your dairy check-off investment through The Dairy Innovation Center has allowed the center to become a national leader in doing life cycle analysis (LCA) to determine the industry’s carbon footprint. This LCA takes into account the entire input and output as a system of producing milk from the farm to the consumer.

Science has come a long way and produced many research-based conclusions on how we can improve our methods for a more sustainable environment. Seeing soil conservation practices such as minimum tillage, crop rotations and contour strip farming, just to name a few of the most important practices to be adapted in crop production, no longer is novel. Soil scientists remind us that the Dust Bowl years demonstrated that those farming practices were not sustainable. Today we better manage our manure to minimize the risk of runoff and capture much of its value as fertilizer. Sure, we may be doing this because it saves us money, but it is also the sustainable thing to do. Questions we should be asking ourselves today are: Will the next generation continue the same practices we do now? Are there practices that we could be doing now to further reduce inputs, reduce energy consumption, reduce odor, and reduce GHG and our carbon footprint?

Social - The “people” portion of this model is the least understood and the most difficult to comprehend. When it comes to people and our society, both rural and urban, sociology is quite different from what many of us are accustomed to understanding. This social leg of the model is confounded with lots of rules and regulations, all written by people who, unfortunately, are not farm people. Yet they are telling us how to treat the environment and to manage our animals, and what is
best for our employees. So as you might imagine, this field of study is about what people think about what we do. We know the bottom line is about farm families, their personal values and the quality of life - for everyone.

For example, we think that if a cow milks a lot, she is in excellent condition, but maybe not stressed. We talk in terms of cow comfort, rather than animal welfare. But when you listen to consumers walking through the dairy barn at the state fair, their questions are not about whether the cow is comfortable, but rather how she is being treated. What is the minimum level of care that is acceptable? We are in the public eye every day and now find ourselves trying to defend what we do for a living and how we produce their food.

So, where is the dairy industry heading with sustainability? One thing is certain: We all need to do our part by supplying policymakers with science-based information. We also need to reach out to consumers with information about our farming practices and why we do what we do, in an understandable manner. That means reaching out to our neighbors, not just waiting for them to come to us (or blame us) to restore their trust and become as visible as “Main Street” is in the community. At the same time, we have the responsibility to feed a growing world population in a way that keeps our farm families in business, while not compromising the ability of future generations to have the same opportunities we have, because sustainable farms lead to a sustainable work force, which sustains our rural communities.

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NOTES
Reducing Fear Improves Milk Production

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People have known for a long time that rough handling and stress is detrimental to dairy cattle. Over 100 years ago, W. D. Hoard, founder of Hoard's Dairyman, wrote that people working with dairy cows should have patience and kindness. He knew that rough treatment lessened the flow of milk. Jack Albright, professor emeritus at Purdue University, likewise stated that tame dairy cows willing to approach people will give more milk. Despite these well-known facts, people have forgotten Hoard's and Albright's message.

Over time, researchers have used statistical methods to document the damaging effects rough handling causes. In fact, shocking a cow or hitting her can reduce milk yield by 10 percent. Cows that are fearful of people are less productive, documents Australian Paul Hemsworth. Fearfulness was determined by the degree of restlessness the cow displayed when a person was close to her during milking. Cows that avoided people and became restless when a person was nearby had lower milk production. And, observations at a large dairy (anonymous communication) indicated that tame cows gave more milk.

Fear memory formation...

What makes a cow fearful of people? Animals have excellent memories for both good and bad experiences. Research on the brain by Joseph LeDoux at New York University shows that animals can experience fear memories that cannot be erased. These fear memories are located in a part of the brain called the amygdala, which is the lower more primitive part of the brain under the cortex.

Fear memories are permanent. Back in the times when cows were wild animals, they would be more likely to be eaten by predators if they forgot where they had encountered a predator such as a lion. Over time, animals can learn to override a fear memory and become less fearful of the place where a scary experience occurred. But they can only override the fear memory it can never be erased. The emphasis has to be on preventing fear memories.

Cows and other animals tend to develop fear memories, which are linked to either bad places or prominent objects. Animals are most likely to become fearful of a specific place or of a person wearing a certain type of clothing associated with a painful or scary experience.

It would be very detrimental for milk production if a cow becomes afraid of the milking parlor. It is essential that a heifer's first experience in the milking parlor is a good experience. First experiences make a big impression on animals. If a heifer falls down or is shocked with an electric prod the first time she enters the parlor she may develop a fear memory that is associated with the parlor.

Research done with rats shows the powerful effects of forming a fear memory. Rats were placed in a maze and allowed to explore all the alleys. If a rat was given a shock the first time it entered a new alley it would never enter that alley again. However, if the rat entered the alley several times and
found food, that provided a positive memory. If it received a shock after the fifth time it entered, and still received food, the rat was be likely to continue to enter that alley.

"Cows do not recognize human faces; they recognize places, smells, voices, distinctive clothing, and certain objects." -- Temple Grandin.

If an animal has a painful or scary experience the first time it enters a new place, then the fear memory is associated with the new place. But, if a painful or scary event happens in a familiar place that has previously been safe, the cow will most likely associate it with some other thing such as a person wearing a yellow raincoat. The fear memory will be associated with the raincoat instead of the place. The fear memory can resurface in any place the cow sees a yellow raincoat.

**Introducing heifers to the parlor...**

Care must be taken to ensure that nothing bad happens to a new heifer when she first walks through the parlor. Animals are naturally wary of new places. If a new experience is suddenly shoved in the animal's face, it is more likely to be fearful. One of the best low-stress ways to introduce a new place is to allow animals to voluntarily explore it. In smaller dairies, heifers could be allowed to explore and walk around in the parlor before they freshen. In a large dairy this would probably not be practical.

French researchers have found that young calves that are handled frequently by people (and have positive experiences with people) will grow up into calmer cows with a smaller flight distance.

On a large dairy a person could be hired to pet and handle calves. At the very least, the calf raiser should be a calm, nurturing person. When the heifers get older, they can be further tamed and quieted by a person walking in their pens every day. During this time, they will learn the sound of the familiar person's voice and footsteps. He or she should also wear the same clothing that the milkers wear such as a yellow apron. This will help the heifers to associate milker clothing with a good experience. When the heifers first go in the parlor, they can be calmed by the sound and sight of a familiar, nice, safe person.

Sometimes cows require veterinary treatments, which may cause some pain or discomfort. It is important that these experiences are not associated with milking. To prevent associations with milking, never give an injection when a cow is in a milking stall. The cow should be taken to a veterinary area for treatment. She then learns that the rest of the dairy is "safe."

If possible, milkers should not give injections. If this is not possible, then the milker should wear something very different such as removing his yellow apron and putting on a big blue hat. The cows then learn that they can relax when they see the yellow apron, and the only time they will he anxious is when they see the blue hat. The hat should be a really wild one that no other employee would ever wear. It should be put away after the veterinary treatments in a box where the cows cannot see it. This will work unless a cow has had a bad experience with yellow aprons when she was a calf. Remember, cows do not recognize human faces; they recognize places, smells, voices, distinctive clothing, and certain objects.

**Memories are like pictures...**

Since animals do not have language, they store their memories like pictures in a photo album or as short bits of audio tape. For example, if a cow became afraid of yellow raincoats when she was a heifer, anything that resembles a yellow raincoat may also scare her. A fear of yellow raincoats might be generalized to yellow aprons. Basically, the cow matches what she is seeing and hearing to the fear memories in her brain.
Some dairy managers have found that locking stanchions raise stress levels. This may be due to the methods used to introduce the stanchions. Before a stanchion is ever locked, the animals should associate it with eating. If the locking stanchion is associated with needles, the cow is more likely to be fearful.

To avoid this association, the animal's first experience in the stanchion should be eating. If the calves are gently trained to eat in stanchions, they probably will not associate them with needles, even if they have received injections in them. It is more likely cows will associate the needles with an object such as a red "sharps container" with needles. They will be relaxed when they can't see the container. W. D. Hoard's wisdom has now been proven with science. Scientists have mapped the fear circuits in the brain, and they know how these circuits work. Dairy managers can use this information to train employees on the importance of treating dairy cows with kindness.

"THE RULE to be observed in this stable at all times, toward the cattle, young and old, is that of patience and kindness. A man's usefulness in a herd ceases at once when he loses his temper and bestows rough usage. Men must be patient. Cattle are not reasoning beings. Remember that this is the Home of Mothers. Treat each cow as a Mother should be treated. The giving of milk is a function of Motherhood; rough treatment lessens the flow. That injures me as well as the cow. Always keep these ideas in mind in dealing with my cattle." -- Temple Grandin.

NOTES
Ohio has a rich history of proactively dealing with livestock care issues. It is well-documented that forward-thinking people prepared for industry engagement and assured consumers about the welfare of domestic livestock in Ohio. For example, as early as 1990, Ohio’s livestock community formed the Ohio Farm Animal Care Commission (OFACC) to provide leadership on matters related to farm animal care. Then in 1997, the organization changed its name to the Ohio Livestock Coalition (OLC), retaining OFACC’s mission as a vital part of the OLC. The strength of OFACC and OLC is made possible by the alliances formed among the leadership of Ohio’s proactive livestock and grain commodity organizations. This relationship has remained vital over the past 20 years, in part due to the commitment of management making it a priority to meet throughout the year to continue a unified effort of addressing important issues facing Ohio’s agriculture industry.

As you are probably well aware, in 2009 Ohio became one of the targets for the Humane Society of the United States (HSUS) in their ongoing effort to impose their animal care rules. Ohio’s agriculture community mobilized, bringing together an unprecedented coalition of Ohio agriculture, political leaders, business and labor organizations, non-profit groups that included food banks and local humane societies, and many others. Recognizing the importance of keeping decisions about farm animal care practices in the hands of the Ohio animal care and food safety experts, the coalition worked with the Governor and his Legislature to place a constitutional amendment on the ballot, known as Issue 2 that created the Ohio Livestock Care Standards Board. Hereafter referred to as the Board, it comprised of a cross section of our livestock industry and included veterinarians, family farmers, food safety experts, agriculture education leaders, local humane society representatives, and consumers charged with developing Ohio’s policy to govern the care of domestic livestock, to ensure the safety of Ohio’s locally grown food supply, and to protect Ohio family farms from unfair policies.

In further support of the initiative, Ohio’s livestock and grain organizations established the Ohioans for Livestock Care (OFLC) Political Action Committee, charged with implementing a statewide campaign to educate legislators and citizens about the importance of this Board. On November 3, 2009, with broad-based industry support and ardent consumer approval, the Ohio voters overwhelmingly passed Issue 2 with a 64 percent margin of support. However, even though this was a decisive victory for Ohio agriculture, we were certain this would not end HSUS’s efforts to dominate the standards set for farm animal.

Almost immediately, the organization - Ohioans for Humane Farms, with support from HSUS, began collecting signatures to add a constitutional amendment to the 2010 ballot, which would override the authority of the newly established Board. In response, OFLC activated its coalition members, reassembled its campaign team, and deployed a strong grassroots plan to educate Ohioans about animal care and the importance of the Board being allowed to do its job.

I am glad to report the efforts of the OFLC paid off. Ohio’s Governor and its farm organizations met with HSUS leaders, and together they are now on a better path to addressing the livestock care debate; rather than taking it to a controversial, emotional, and costly ballot initiative for consumers to vote on. Following an open, good-faith discussion, Ohio’s farm community announced it had reached
a landmark agreement with HSUS that stopped them from pursuing the planned initiative effort, and
one that would ensure the future of our newly established Ohio Livestock Coalition Board. In
addition, the groups declared agreement on some livestock care recommendations for the Board to
consider. The agreement between Ohio agriculture and HSUS accomplished what Ohio farmers
wanted all along – for decisions about farm animal care to be made under the guidance of Ohio
animal care and food safety experts.

Presently, the Board is considering these recommendations, as well as other relevant farm animal
care issue. Ohio’s livestock industry is involved in the development of these standards through its
various livestock species subcommittees. Representing the best interest of Ohio dairy farmers, the
Ohio Dairy Producers Association (ODPA) has fully embraced this process and has been
instrumental in coordinating input from our dairy farmers, veterinarians, allied industry, dairy
processors, and food service companies in an effort to identify and recommend practical dairy care
standards for the Board’s consideration.

NOTES
Lameness: Effects on Performance, Profit, and Welfare

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Effects of Lameness on Performance

Few if any diseases in dairy cattle impact the performance, profitability and welfare of animals more than lameness. A Cornell University study found that milk yield was reduced two weeks before and three weeks after lameness was detected in cows. A Florida study of cows affected with foot rot determined that mean milk production was decreased by 10% (1,885 lb/cow) compared with unaffected animals. This study also found that of cows affected 80% were in early lactation, and of those 60% were culled before completing the lactation.

A California study observed that as locomotion score increased (lameness increased) milk yield decreased. Reproductive performance is also negatively affected by lameness. A United Kingdom study of 427 cases of lameness from 17 herds found increased intervals between calving to 1st service of 4 days and calving to conception of 14 days. Pregnancy rates to 1st service were 46% in lame cows compared to 56% in non-lame cows. Services per conception and overall cull rates were increased in non-lame versus lame cows from 1.72 to 2.14 and 5% to 16%, respectively. A Florida study observed that lameness increased the calving to conception interval in affected cows from 100 days to 140 days in cows with claw lesions and as much as 170 days in cows with multiple foot lesions. Another Florida study by Melendez, et al., found that cows becoming lame within the first 30 days of lactation had lower conception rates (17.5% versus 42.6%), lower overall pregnancy rate (85% versus 92.6%) and a higher incidence of cystic ovarian disease (25% versus 11%).

While many of the effects of lameness have been assumed to be indirect, a Florida study by Garbarino et al., demonstrated direct effects on the ovary and thus ovarian activity resulting in lame cows having 3.5 greater odds of experiencing delayed cyclicity as compared with non-lame cows. These observations were corroborated by Morris and Walker, who found that lame cows (30/42) were less likely to ovulate as compared with non-lame cows (30/32). And finally, a study by researchers in India found that although estrus duration was similar for lame and non-lame cows, the intensity of estrous activity was significantly subdued in cows exhibiting lameness. There is little question that lameness has dramatic effects on animal performance and longevity and that these have a huge impact on profitability.

Effects Lameness on Profitability

If one were to pose the following question “What is the most costly disease of dairy cattle?” the most common response would likely be “mastitis”. Indeed, there was a time in our dairy history where this was the correct answer. Fortunately, we’ve made important progress in the dairy industry by addressing such problems as subclinical mastitis, particularly that caused by Streptococcus agalactiae. Post-milking teat dipping and dry cow therapy have virtually eliminated this pathogen from many herds.
Today, the common answer to this question is “lameness”, and is due in large part to changes in housing and management practices during this same period of time. Calculations by Dr. Chuck Guard from Cornell University indicate that on an individual cow basis lameness ($478/case) and left displaced abomasum ($489/case) are the most costly disease disorders. Mastitis at a cost of $262/case ranks 5th behind retained placenta/metritis ($325/case) and milk fever ($284/case) as the most costly diseases of dairy cattle. However, when the economic impact of disease is computed on a herd basis (cost/100 cows), nothing rivals factors associated with lameness as the single most costly disorder of dairy cattle. Lameness found at rates of 30 to 50% or higher in herds has replaced mastitis as the most prevalent ailment of dairy cattle.

The consequences of lameness contribute to costs that result from death, premature culling, milk losses, reduced reproductive performance, and treatment. Direct effects of lameness are reported to account for 15% of culling in U.S. dairy herds. Based on these data, it has been estimated the indirect effects of lameness on production and reproduction could account for an additional 49% of culling in U.S. dairy herds. With lameness as the underlying or direct cause for 64% of the cows that leave these herds, it is clear that lameness represents one of, if not the most costly diseases to dairy cattle enterprise profitability.

Effects of Lameness on Animal Welfare

Words Are Important! Welfare is a seriously misunderstood term. It is unfortunate that a dairyman or any cattleman would take offense to being called an “animal welfarist”. How sad this is, and how counterproductive it is to their (our) cause. Instead of embracing the term “welfare”, we as an industry have replaced it with the term “well-being”. We assume this expression somehow projects a more positive image. While there is nothing wrong with the term well-being, the point I wish to make is simple: our rejection of the term “welfare” gives the critics of animal agriculture unintended leverage against our practices that is unfounded and our industry an image that is counterproductive to sustainability. Animal welfare is not the process of ascribing human values to animals; that is an “animal rights” philosophy. Rather, if you share a concern for animals, it’s not because you’re an “animal well-beingist”, it’s because you’re an “animal welfarist”. Let us look at some definitions that might help to put my comments into perspective.

The term animal welfare refers to the “state of the animal”. As defined by Dr. Donald M. Broom, a well known animal behavior and welfare scientist from the University of Cambridge, welfare describes “An animal’s state as regards its attempts to cope with its environment”. When describing animal welfare, it implies the animal’s feelings, its behavioral, its physiological responses, and its state of health. So, when we refer to ourselves as welfarists, we are saying that we are concerned about the state of the animal. Therefore, we acknowledge the state of an animal can be positive (good) or negative (not-so-good, or bad). Well-being, on the other hand, is the state of being happy, healthy and prosperous. While this perhaps describes our animal welfare objective, in itself, the term well-being does not describe or acknowledge the total spectrum of an animal’s state of being as bad or good; it only refers to that idyllic, positive state.

The primary concerns in animal welfare typically include three basic questions: 1) is the animal functioning well (in other words, is it producing well), 2) does the animal express pain or distress (affective states), or 3) is the animal able to express or perform natural behaviors (Frazer, 2008; Von Keyserlingk et al., 2009)?

For example, consider lameness in the context of these questions. By these measures, one can see that we fail to achieve the objectives of good welfare. Why, because it affects the animal’s ability to function. Lameness reduces milk yield and diminishes reproductive performance. Lameness causes pain as exhibited by an altered gait. And finally, lameness interferes with the animal’s ability to
express normal behavior, i.e. lame cows do not move freely or confidently. Hence, they interact less with herd mates including activities associated with estrus behavior and social interactions that establish the level of dominance with herd mates.

References available on request to the author.
Dairy Carbon Footprints: A Tool for Your Farm

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Greenhouse Gas Emissions from Livestock

Agriculture can be both a source or sink (removal or sequestration) for greenhouse gases. Agriculture contributes approximately 6% of the total greenhouse gas emissions for the United States (EPA, 2010). Most agricultural emissions originate from soil management, enteric fermentation and manure management. Dairy production accounts for approximately a quarter of the emissions from livestock, driven by the methane produced during ruminations.

Life-Cycle Analysis and Carbon Footprints

Life-cycle analysis or LCA is a method of resource accounting where quantitative measures of inputs, outputs and impacts of a product are determined. This can involve many different environmental impacts. When only greenhouse gas emissions are quantified, the results of the life-cycle analysis are called a carbon footprint.

The LCA method is commonly used to find process or production improvements, compare different systems or products, find the ‘hot spots’ in a product’s lifecycle where the most environmental impacts are made, or to help companies or consumers make informed sourcing decisions.

Figure 1 is an example of finding the hot spots in the ‘generic’ retail chain of fluid milk, showing that the majority of the carbon footprint originates before the farm gate. This helps focus the research and analysis in areas where it can have the most impact. Further life-cycle assessments, such as Figure 2, can help evaluate technology or management changes in specific farming systems and regions.

Another advantage of using a full life-cycle assessment is that it helps avoid shifting environmental impacts from one area to another. Such as implementing a management change that reduces greenhouse gases, but increases dust, or evaluating if a change made at the livestock facility will increase emissions from feed production.

Variation in Life-Cycle Analysis and Carbon Footprint Results

Different researchers may get different results when performing a LCA on the same product. This can happen for many reasons, including differences in:

- Inclusion/exclusion of secondary sources
- Inclusion/exclusion of biogenic CO₂
- Inclusion/exclusion of CO₂ from fuel combustion
- System boundary definition
- Functional relationships used
- Global warming potential indexes
- Inclusion/exclusion of carbon sequestration
Reducing Your Dairy Carbon Footprint

- Increase production per animal
- Select more digestible feeds
- Cover manure storage and flare vented gas
- Digest manure to create biogas/electricity
- Better match nitrogen needs in animal rations and crop fertilization
- Reduce replacement rate - increase fertility, herd health
- Decrease age of first calving
- Increase carbon sequestration
- Increase on-farm energy efficiency

Case Study: Using DairyGHG to Evaluate Management Options

“The Dairy Greenhouse Gas Model (DairyGHG) is a software tool for estimating the greenhouse gas emissions and carbon footprint of dairy production systems” (Rotz, 2010). The model was developed by researchers at the USDA Agricultural Research Service. It incorporates emissions from the dairy farm with those from the production of resources used on the farm such as feed, machinery, fuel, electricity, and fertilizer. This tool allows an operation to enter the specific conditions for the farm and then compare management options. DairyGHG is available for free download at http://www.ars.usda.gov/Main/docs.htm?docid=17355.

Figure 1. Supply chain contribution to carbon footprint of ‘generic’ milk. Generic milk refers to regional-production-weighted (raw milk input) and purchase-volume-weighted (milk fat content) average milk consumed in the U.S. during 2007 (Thoma et al., 2010).
Figure 2. Comparison of dairy management options with DairyGHG model, kg CO$_2$e/kg ECM (Rotz, 2010).

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NOTES
Molds and Mycotoxins in Your Dairy Feeds

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Mold Growth, Mycotoxin Formation

Mycotoxins are poisons frequently produced by molds in feeds. Molds can grow pre-harvest or post-harvest; during storage, transport, processing or feeding. Mold growth and mycotoxin production are related to plant stress caused by weather extremes, insect damage, inadequate storage practices, and faulty feeding conditions. Molds grow over a wide range of conditions, but generally grow better with moisture above 15%, at warmer temperatures, at a neutral pH and in the presence of air. In wet feeds such as silage, high moisture contents helps exclude air, but molds will grow if sufficient oxygen is present.

Most common mycotoxins of concern are produced by Aspergillus, Fusarium and Penicillium species of molds. Aspergillus species normally grow at lower water activities and at higher temperatures than the Fusarium species and therefore, aflatoxin in corn is favored by the heat and drought stress associated with warmer climates and is more likely to occur in peanuts, cottonseed from the southwestern U.S. and corn grown in the southern states. In some years, weather conditions result in production of aflatoxin in corn in Pennsylvania and other northern states. The individual Penicillium species have variable growth requirements, but are more likely to grow under post-harvest conditions, in cooler climates, in wet conditions, and at a lower pH. Penicillium molds are a contaminant of silage, probably because they are acid tolerant. The Fusarium species are important plant pathogens that can proliferate pre-harvest, but continue to grow post-harvest. In corn, Fusarium molds are associated with ear rot and stalk rot, and in small grains, they are associated with diseases such as head blight (scab). In wheat, Fusarium is associated with excessive moisture at flowering and early grain-fill stages. In corn, Fusarium graminearum is referred to as a red ear rot and is more commonly associated with a cool, wet growing season and with insect damage. Fusarium ear rots that produce fumonisins are referred to as pink ear rots and vary in their environmental requirements, but are often associated with dry conditions in mid-season followed by wet weather.

Mycotoxins

There are hundreds of mycotoxins that have been identified and it is expected that many more exist. Mycotoxins are very chemically diverse. The primary classes of mycotoxins are aflatoxins, zearalenone, trichothecenes, fumonisins, ochratoxin A, and the ergot alkaloids. Biological effects of mycotoxins include liver and kidney toxicity, central nervous system effects, immune suppression, estrogenic effects and others.

Mold Infections

A mold (fungal) infection resulting in disease is referred to as a mycosis. Fungal pathogens include: Aspergillus fumigatus, Candida albicans, Candida vaginitis, certain species of Fusarium and others. Aspergillus fumigatus is known to cause mycotic pneumonia, mastitis and abortions and has been proposed as the pathogenic agent associated with mycotic hemorrhagic bowel syndrome (HBS) in dairy cattle. It is thought that mycotoxins, by reducing immunity, help the mold to infect animals.
While healthy cows with an active immune system are more resistant to mycotic infections, dairy cows in early lactation are immune suppressed and HBS is more likely. Feeding a commercial mycotoxin adsorbent with anti-fungal and immune stimulatory properties has reduced incidence of HBS.

**Mycotoxin Effects**

Mycotoxins, in large doses, can be the primary agent causing acute health or production problems in a dairy herd. A more likely scenario is to find mycotoxins at lower levels interacting with other stressors and contributing to chronic problems including a higher incidence of disease, poor reproductive performance, or suboptimal milk production. To the animal producer, these chronic losses are of greater economic importance than losses from acute effects, and more difficult to diagnose.

Mycotoxins exert their effects through several means including: 1) reduced intake or feed refusal; 2) reduced nutrient absorption and impaired metabolism; 3) altered endocrine and exocrine systems; 4) suppressed immune function; 5) altered rumen microbial growth, and 6) cellular death.

Symptoms of a mycotoxicosis vary depending on the mycotoxins involved and their interactions with other stress factors. Symptoms result from a progression of effects, and may reflect those of an opportunistic disease. Cows may exhibit a few or many of a variety of symptoms. The more stressed the cow, such as during freshening, the more they are affected; perhaps because their immune systems are already suppressed. Symptoms may include: reduced production; reduced feed consumption; intermittent diarrhea (sometimes with bloody or dark manure); reduced feed intake; unthriftiness; rough hair coat; and reduced reproductive performance including irregular estrous cycles, embryonic mortalities, pregnant cows showing estrus, and decreased conception rates. There generally is an increase in incidence of early lactation diseases such as displaced abomasum, ketosis, retained placenta, metritis, mastitis, and fatty livers. These cows do not respond well to veterinary therapy.

Diagnosis of a mycotoxicosis can be difficult due to the complicated clinical situation resulting from a tide of events which can produce a wide range of generic symptoms; symptoms that may be due to secondary disease. The level of difficulty of diagnosis is increased due to many factors including: limited research, exposure to multiple mycotoxins, uneven distribution of these mycotoxins in the environment, the method of sampling, problems with the method of analysis, and interactions confounded with other physiological stressors. Because the diagnosis is difficult, determining a mycotoxin problem becomes a process of elimination and association. Certain observations may be helpful: 1) Mycotoxins should be considered as a possible primary factor resulting in production losses and increased incidence of disease; 2) Documented symptoms in ruminants or other species can be used as a general guide to symptoms observed in the field; 3) Systemic effects as well as specific damage to target tissues can be used as a guide to determine possible causes; 4) Post mortem examinations may indicate no more than gut irritation, edema, or generalized tissue inflammation; 5) Because of the immune suppressing effects of mycotoxins, increased incidence of disease or atypical diseases may be observed; 6) Responses to added dietary adsorbents or dilution of the contaminated feed may help in the diagnosis; and 7) Feed analyses, while helpful, has limited value due to inaccuracies that are inherent to sampling technique, resulting in the analysis of only a few mycotoxins.

**Safe Levels of Mycotoxins**

Some of the same factors that make diagnosis difficult also contribute to the difficulty of establishing levels of safety. These include lack of research, sensitivity variation among animal species,
imprecision in sampling and analysis, the large number of potential mycotoxins, and interactions with stress factors or other mycotoxins. The FDA has established action, guidance and advisory levels, in part, to protect public health. Grains with mycotoxin(s) that exceed the appropriate action, advisory or guidance levels may be considered by the Center for Veterinary Medicine (CVM) as adulterated and may furthermore be considered by CVM as unfit for use in animal feed.

Toxicity of Individual Mycotoxins

Aflatoxin. Aflatoxins are extremely toxic, mutagenic, and carcinogenic compounds produced by Aspergillus flavus and A. parasiticus. Aflatoxin B1 is excreted in milk in the form of aflatoxin M1. The FDA limits aflatoxin to no more than 20 ppb in lactating dairy feeds and to 0.5 ppb in milk. A thumb rule is that milk aflatoxin concentrations equal about 1.7% (range from 0.8 to 2.0%) of the aflatoxin concentration in the total ration dry matter. Cows consuming diets containing 30 ppb aflatoxin can produce milk containing aflatoxin residues above the FDA action level of 0.5 ppb. Aflatoxin appears in the milk rapidly and clears within three to four days.

Symptoms of acute aflatoxicosis in mammals include: inappetance, lethargy, ataxia, rough hair coat, and pale, enlarged fatty livers. Symptoms of chronic aflatoxin exposure include reduced feed efficiency and milk production, jaundice, and decreased appetite. Aflatoxin lowers resistance to diseases and interferes with vaccine-induced immunity. In beef cattle, diets containing in excess of 500 to 800 ppb aflatoxin can reduce intake, however liver weights may be affected with aflatoxin levels as low as 100 ppb. Production and health of dairy animals may also be affected at dietary levels of aflatoxin above 100 ppb, but levels above as little 30 ppb are expected to create illegal milk residues. The current FDA action levels for aflatoxin in livestock feed are presented in Table 1.

<table>
<thead>
<tr>
<th>Class of Animal</th>
<th>Feed</th>
<th>Aflatoxin Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finishing beef cattle</td>
<td>Corn and peanut products</td>
<td>300 ppb</td>
</tr>
<tr>
<td>Beef cattle, swine or poultry</td>
<td>Cottonseed meal</td>
<td>300 ppb</td>
</tr>
<tr>
<td>Finishing swine over 100 lb.</td>
<td>Corn and peanut products</td>
<td>200 ppb</td>
</tr>
<tr>
<td>Breeding cattle, breeding swine and mature poultry</td>
<td>Corn and peanut products</td>
<td>100 ppb</td>
</tr>
<tr>
<td>Immature animals</td>
<td>Animal feeds and ingredients, excluding cottonseed meal</td>
<td>20 ppb</td>
</tr>
<tr>
<td>Dairy animals, animals not listed above, or unknown use</td>
<td>Animal feeds and ingredients</td>
<td>20 ppb</td>
</tr>
</tbody>
</table>

Deoxynivalenol (DON) or Vomitoxin. Deoxynivalenol is a Fusarium produced mycotoxin, commonly detected in feed. It is sometimes called vomitoxin because it was associated with vomiting in swine. Surveys have shown DON to be associated with swine disorders including: feed refusals, diarrhea, emesis, reproductive failure, and deaths. The impact of DON on dairy cattle is not established, but clinical data show an association between DON and poor performance in dairy herds. Dairy cattle consuming diets predominately contaminated with DON have responded favorably to the dietary inclusion of a mycotoxin binder. Such reports provide circumstantial evidence that DON may reduce milk production and substantiate field reports with similar conclusions. DON has been
associated with altered rumen fermentation, reduced flow of utilizable protein to the duodenum, decreases in humoral and cell-mediated immunity, and a reduction in host resistance.

The presence of DON indicates the feed source was exposed to an environment conducive to mold growth and the potential formation of several mycotoxins. Like many mycotoxins, when pure DON is added to the diet, it produces fewer toxic symptoms than when DON-infected feeds are fed from naturally contaminated feeds. It is reasonable to surmise these non-purified or naturally contaminated feeds are more virulent because of the presence of multiple mycotoxins. In many cases, mycotoxins will interact to produce symptoms that are different or are more severe than expected. For example, fusaric acid interacts with DON to cause the vomiting effects, which earlier was attributed to DON alone. Established advisory levels for DON are provided by FDA and shown in Table 2.

<table>
<thead>
<tr>
<th>Animal Class</th>
<th>Feedstuff</th>
<th>Ingredient Max.</th>
<th>Total Diet Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ruminating dairy, beef and feedlot cattle older than 4 months &amp; chickens</td>
<td>Grain and grain by-products at 88% DM &amp; not to exceed 50% of chicken diets</td>
<td>10 ppm</td>
<td>10 ppm – beef</td>
</tr>
<tr>
<td></td>
<td>Distillers grains, brewers grains, and gluten meals derived from grains (on an 88% dry matter basis)</td>
<td>10 ppm</td>
<td>5 ppm dairy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 ppm</td>
<td>5 ppm chickens</td>
</tr>
<tr>
<td>Swine</td>
<td>Grain and grain by-products at 88% DM not to exceed 20% of the diet</td>
<td>5 ppm</td>
<td>1 ppm</td>
</tr>
<tr>
<td>All other animals</td>
<td>Grain and grain by-products at 88% DM not to exceed 40% of the diet</td>
<td>5 ppm</td>
<td>2 ppm</td>
</tr>
</tbody>
</table>

T-2 Toxin (T-2). T-2 toxin is a very potent Fusarium produced mycotoxin that fortunately is less common than some others. The effects of T-2 are less well established in cattle than in laboratory animals, where T-2 toxin is known to be a very potent toxin. T-2 reduces protein synthesis and thereby reduces immunity. In dairy cattle, T-2 has been associated with gastroenteritis, intestinal hemorrhages, and death. Dietary T-2 toxin above 500 to 600 ppb may result in bloody feces, enteritis, abomasal and ruminal ulcers, and death. Low feed consumption, decreased milk production, and absence of estrous cycles has also been observed in dairy cows exposed to T-2. Calves exposed to T-2 toxin may have lower white blood cell and neutrophil counts, as well as lower serum immunoglobulins and complementary proteins. Guidelines for T-2 toxin are not well established, but avoiding levels above 100 ppb is suggested. Other Fusarium spp. produce such mycotoxins as diacetoxyscirpenol, HT-2, and neosolaniol, which can occur along with T-2 toxin and contribute to similar symptoms. The FDA has no established guidelines for T-2 toxin levels in feedstuffs.

Zearalenone (ZEA). Zearalenone is a Fusarium produced mycotoxin that has a chemical structure similar to estrogen and can produce an estrogenic response in animals. Zearalenone is associated with ear and stalk rots in corn and with scab in wheat. Controlled studies with ZEA at high levels have failed to reproduce the degree of estrogenic symptoms that has been associated with...
ZEA contaminated feeds in field observations. Field reports have related ZEA to estrogenic responses in ruminants including abortions, vaginitis, excessive vaginal secretions, poor reproductive performance, increased reproductive tract infections, and mammary gland enlargement in virgin heifers. It has been noted that dairy herds with high levels of blood "zearalenone" have low fertility and within such herds, individual cows with high "zearalenone" were not cycling. Reproductive problems in dairy cattle have been associated with dietary ZEA concentrations of about 300 to 500 ppb or greater. The FDA also has no established guidelines for zearalenone in feeds. Any contamination issue should be dealt with on a case by case basis.

**Fumonisin (FB).** Fumonisin B1 produced by *F. verticilloides*, was first isolated in 1988. It causes leukoencephalomalacia in horses, pulmonary edema in swine, and hepatotoxicity in rats. It is carcinogenic in rats and mice and may be a promoter of esophageal cancer in humans. Fumonisins are structurally similar to sphingosine, a component of sphingolipids, which are in high concentrations in certain nerve tissues such as myelin. Fumonisin toxicity results from blockage of sphingolipid biosynthesis and thus degeneration of tissues rich in sphingolipids.

While FB1 is much less potent in ruminants than in hogs, it has now been shown toxic to sheep, goats, beef cattle, and dairy cattle. High levels of fumonisin can reduce intake, weight gain, and cause liver damage in ruminants. Dairy cattle (research with Holsteins and Jerseys) fed diets containing 100 ppm fumonisin per day for approximately 7 days prior to freshening and for an additional 70 days thereafter, yielded lower milk production (13 lb./cow/day). These results were attributed primarily to their reduced feed consumption. Increases in serum enzyme concentrations also suggested mild liver disease was affecting cow health. Remember, corn screenings contain about 10 times the fumonisin content than the corn from which they were derived. A suggested fumonisin level guide is found in Table 3.

Table 3. FDA guidance levels for total fumonisins in animal feeds.

<table>
<thead>
<tr>
<th>Class of Animal</th>
<th>Feed Ingredients &amp; Portion of Diet</th>
<th>Levels in Corn &amp; Corn By-products</th>
<th>Levels in Finished Feeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equids and Rabbits</td>
<td>Corn and corn by-products not to exceed 20% of the diet **</td>
<td>5 ppm</td>
<td>1 ppm</td>
</tr>
<tr>
<td>Swine and Catfish</td>
<td>Corn and corn by-products not to exceed 50% of the diet**</td>
<td>20 ppm</td>
<td>10 ppm</td>
</tr>
<tr>
<td>Breeding Ruminants, Breeding Poultry and Breeding Mink*</td>
<td>Corn and corn by-products not to exceed 50% of the diet**</td>
<td>30 ppm</td>
<td>15 ppm</td>
</tr>
<tr>
<td>Ruminants up to 3 Months Raised for Slaughter and Mink Raised for Pelt Production</td>
<td>Corn and corn by-products not to exceed 50% of the diet**</td>
<td>60 ppm</td>
<td>30 ppm</td>
</tr>
<tr>
<td>Poultry being Raised for Slaughter</td>
<td>Corn and corn by-products not to exceed 50% of the diet**</td>
<td>100 ppm</td>
<td>50 ppm</td>
</tr>
<tr>
<td>All Other Species or Classes of Livestock and Pet Animals</td>
<td>Corn and corn by-products not to exceed 50% of the diet**</td>
<td>10 ppm</td>
<td>5 ppm</td>
</tr>
</tbody>
</table>

* Includes lactating dairy cattle and hens laying eggs for human consumption.
** Dry weight basis.
**Ergot alkaloids, including fescue toxicity.** One of the earliest recognized mycotoxicoses is ergotism caused by a group of ergot alkaloids. They are produced by several species of *Claviceps*, which infect the plant and produce toxins in fungal bodies called sclerotia or ergots, which are small black colored bodies similar in size to the grain in which they are found. Ergotism primarily causes either a gangrenous or nervous condition in animals. The symptoms are directly related to dietary concentration including reduced weight gain, lameness, lower milk production, agalactiae, and immune suppression. Sclerotia levels above 0.3% by weight of the diet have been associated with reproductive disorders. Most grasses can host ergot producing molds.

Fescue grass infected with *Neotyphodium* or *Epichloe* can contain ergot alkaloids and cause “fescue toxicity”. The symptoms often include lower weight gains, rough hair coat, elevated body temperature, agalactia, reduced conception rates, and gangrenous necrosis of the extremities such as the feet, tail and ears. Fescue is a major pasture grass throughout the lower Midwest and upper South, and it is estimated that over half is thought to be infected with ergot. More than 20% of U.S. beef cattle graze fescue pastures, making ergotism a potentially serious problem for many cattle producers.

**PR toxin and other *Penicillium* produced mycotoxins.** PR toxin is one of the several mycotoxins produced by *Penicillium* molds. *Penicillium* grows at a low pH and in cool damp conditions and has been found to be a major contaminant of silage. PR toxin, produced by *P. roquefortii*, is highly toxic and has been suggested as the causative agent associated with moldy corn silage problems. Surveys of grass and corn silages in Europe have found occurrences of *P. roquefortii* in up to 40% of samples and associated the toxins with cattle disorders. PR toxin caused acute toxicity in mice, rats, and cats that caused increased capillary permeability and resulted in direct damage to the lungs, heart, liver, and kidneys. Furthermore, it was the suspected vector in another case study that included the symptoms of abortion and retained placenta. Other *Penicillium* produced mycotoxins in silages, such as roquefortine C, and mycophenolic acid have also been linked with herd health problems.

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