

What's New For 2020



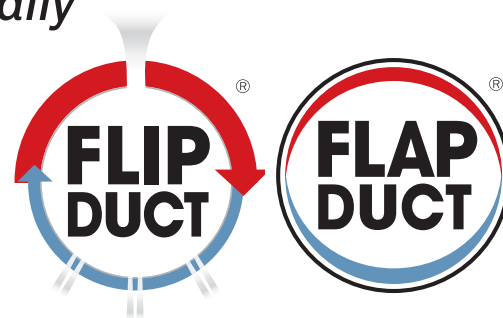
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Egg Yolk Color And How To Manage It



By Dan Leiterman

Food color and presentation matters. Color is an important sensory factor that helps consumers determine food quality and its potential health benefits. Richly colored egg yolks for example, can only come from healthy layers that have been fed a well-balanced,

nutrient rich diet. Hens need to be healthy enough to convert their diet properly in order to pass critical nutrients into the egg (primarily the yolk). Egg yolks are an excellent source of key nutrient dense compounds such as proteins, fats, minerals, vitamins, antioxidants and trace minerals that are essential to our good health. Consumers associate a strong yolk color with a healthy, nutrient rich food. There is a growing market demand for eggs with rich yolk coloring.

Darker/richer yolk coloring happens when layers eat a diet that contains high levels of powerful carotenoid antioxidants and are healthy enough to process the diet properly. The birds take the carotenoids from the diet and transfer the antioxidants to the egg yolk. The higher levels and specific combinations of key carotenoids provided to the bird will result in a richer, golden colored egg yolk, along with higher levels of antioxidants. These darker colored egg yolks can be typically found with small family flocks, where the layers are able to forage on carotenoid rich plant material to supplement their diet. In today's more commercialized egg production however, the birds may have limited, or no access to free choice green plant material. Consequently, concentrated forms of key carotenoids need to be strategically added to the layer diet in order to enrich the egg yolk with these important antioxidants. This will result in the golden colored, antioxidant rich egg yolk that consumers desire.

How To Measure Egg Yolk Color

The options for measuring egg yolk color are as follows¹:

1. HunterLab Scale: An objective analysis which measures lightness, redness and yellowness with mechanical equipment such as a colorimeter that expresses color according to the HunterLab Scale.
2. DSM YolkFan™ Color Scale (Figure 1): Has a fan of color strips numbered from 1 to 16 with colors ranging from 1 being a very pale yellow up to the 16 being a dark orange color. This is a subjective method, but is very popular and is referenced commonly around the world.
3. Spectrophotometry: Determines the carotenoid content as beta-carotene equivalent standardized method (BCE), i.e. the iCheck Egg method. Typically used for colors over 16 on the DSM scale and is very accurate.

A typical target egg yolk color on the DSM Color Fan, for good consumer acceptance, is a score of 7.

Figure 1

DSM YOLKFAN™



Figure 2

TYPICAL LAYER DIET XANTHOPHYLL CONTRIBUTIONS

Feed Ingredient	Xanthophyll Content (Lutein & Zeaxanthin) Yellow Pigment (ppm)			Inclusion (% of diet)	Xanthophylls Contribution (ppm)
	Range (ppm)	Typical Lutein (ppm)	Typical Zeaxanthin (ppm)		
Yellow corn	5 to 20	10	8	51.6 %	9.29
Alfalfa meal (17%)	770	690	80	2.5 %	19.25
Other ingredients				45.9 %	0
Total xanthophyll content of feed				100 %	28.54 ppm

Figure 3

COMMERCIALLY PREPARED ADDITIVE SOURCES OF YELLOW PIGMENT FOR EGG YOLK COLORING

Additive	Xanthophyll Content (ppm) For Yellow Pigment			Inclusion (% of diet)	Xanthophylls Contribution (ppm)
	Range (ppm)	Typical Lutein (ppm)	Typical Zeaxanthin (ppm)		
Marigold	18,090	13,400	4,690	1 lb./ton	9.05
Ora-Glow	10,000	n/a	n/a	1 lb./ton	5.0

What Affects Egg Yolk Color

CAROTENOIDS: The color of an egg yolk is directly related to the amount and types of carotenoids in the layer's diet. There are over 1,100 known carotenoids which are antioxidant pigments found in plants, algae and photosynthetic bacteria. Carotenoids can be categorized into two classes of compounds based on differing chemistry and pigmentation. They are carotenes and xanthophylls.³

1. **Carotenes** (contain no oxygen): are a yellow or red pigment found in dark green, leafy, and yellow vegetables such as collards, turnips, carrots, sweet potatoes, squash, yellow fruit, milk, egg yolk and body fat. Carotenes can be converted into vitamin A in the body.
2. **Xanthophylls** (contain oxygen): are yellow pigments found in the leaves of most green plants. There are a number of different xanthophylls, two in particular are important to

yolk coloring: lutein and zeaxanthin. Both lutein and zeaxanthin are important in the human diet. One example is that they support healthy retina tissue in the eye and reduce the risk of macular degeneration.

Some ingredients used in poultry nutrition can have significant levels of xanthophylls (Figure 2 and Figure 3)^{3,4}.

Figure 2 shows a typical layer diet with yellow corn as the primary energy source, using typical estimates of xanthophyll (yellow color) levels in the corn, results in a strong score of 9.29 ppm of xanthophylls in the layer feed. The addition of 50 lbs. per ton of alfalfa meal not only addresses the fiber need for the birds, but it also contributes a significant level of xanthophylls to the egg yolk. Even though the corn/alfalfa diet would result in a bright yellow yolk and not an orange color;

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Egg Yolk Color And How To Manage It

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the yolk still contains an excellent amount of xanthophyll. If a more orange/golden color yolk is desired, a certain amount of carotene (red pigment) needs to be added in addition to the yellow colored xanthophyll sources.

Strategies To Achieve Darker, Orange Egg Yolk Color

Another key principle to consider when targeting a specific egg yolk color, is the fact that both yellow and red pigments are needed to achieve colors above a DSM YolkFan™ score of 7. The first component to pigmenting an egg yolk is the ‘saturation phase’, which involves depositing enough yellow pigments (xanthophylls) to reach at least a DSM YolkFan™ score of 7. This yellow (base saturation phase) is needed in order for the second phase application of a red pigment (carotenes) to be more efficient in achieving the richer golden colors indicated by higher numbers of the DSM YolkFan™ (Figure 4).³ Feeding extreme levels of yellow pigment can result in a very nutrient rich yolk with an excellent yellow color, but this color may only score a 7 or 8 on the DSM YolkFan™ scale. To more effectively move the yolk color higher on the DSM YolkFan™ scale, a red pigment needs to be added to the yellow base saturation. A good analogy would be the color combinations

necessary to achieve a green colored paint. It requires both yellow and blue colors. Extreme levels of yellow will never accomplish a green. Blue needs to be added to the yellow. If the yellow level is too low, the blue will fail to make the desired green as well.

A custom strategy can be developed for any particular barn to increase yolk color, depending on the many variables that a given producer is experiencing, i.e. variability of dietary ingredients, health status of the birds and their digestive tract, stress level and/or nutrient blocks like high iron water or mycotoxins.

What are some good sources of carotene (red pigmentation) that can be added to the layer diet? Paprika powder is a good source of carotene/red pigmentation and is allowed to be added to layer and broiler diets by the Food and Drug Administration (FDA) and the Association of American Feed Control Officials (AAFCO). However, the carotenes in paprika are very unstable, and therefore need to be protected from oxygen exposure in order to maintain a good shelf life. Commercial products like Kem-Glo™ contain paprika, but this product needs to be stabilized (protected from exposure to oxygen) as well in order for it to effectively accomplish higher yolk color goals. Raw paprika can readily lose significant levels of carotenoids (50 to 75%)

Figure 4 CAROTENOIDS (YELLOW & RED PIGMENTS) NEEDED IN A LAYER DIET TO ACHIEVE DSM YOLKFAN™ SCORE

DSM YolkFan™ Score	Xanthophylls Yellow (ppm)	Carotenes Red (ppm)
8	7.5	0.5
9	7.5	1
10	7.5	1.5
11	7.5	2
12	9	3
13	10.5	4
14	10.5	5
15	10.5	5.5
16	12	8

when exposed to air, resulting in the need for higher inclusion rates per ton. Even if straight paprika is used, and assumed to be 100% stable and effective (a doubtful scenario) it would take over 3 lbs. of paprika to provide 0.5 ppm of carotene in a ton of layer feed. Going up the scale of color on **Figure 4** demonstrates that to achieve a level of 1 ppm of carotene would require over 6 lbs. of paprika to be added to the diet (again assuming 100% efficacy). The inclusion rates can go up even more significantly if the product is compromised and the active ingredient is lost. As you can see the additional expense of adding yolk coloring ingredients to the layer's diet begs the question; Is there an appropriate premium paid for the eggs to provide the necessary return on the investment to justify the added expense of adding the xanthophylls and carotenes to the feed³?

Other Factors That Can Negatively Affect Egg Yolk Color

Once the diet is properly formulated to attain the targeted egg yolk color, there are still some potential obstacles to accomplishing the desired color goal. The issue of having a healthy bird is the underpinning to good nutrient utilization, including the carotenoids. Two questions should be asked when designing any livestock diet: 1) Is this a good diet? 2) Can the animal use the diet? These questions highlight the main areas of consideration when working with livestock nutrition to achieve efficient productivity. The following challenges can reduce the bird's ability to effectively use the diet and compromise productivity of the birds. Any of these topics can also impede yolk coloring efforts as well.

1. **Stress:** heat stress, cold stress, crowding, piling, poor handling and nutritional challenges.
2. **Mycotoxins:** possess the capability to reduce organ function, irritate intestinal tissue, damage liver tissue, compromise immune function and tie up nutrients.
3. **Poor digestive function:** digestive tract environment disruption due to infections, mycotoxins or stress.

4. **Reallocation of nutrients:** low vitamin A availability will convert carotenoids to vitamin A.
5. **Disease:** infections can reduce feed efficiency and compromise bird health, i.e. *E. coli*, *Salmonella*, *Clostridium*.
6. **Poor water quality:** high iron and/or high sulfur in water lowers feed efficiency and challenges immune status.
7. **Poor sanitation:** high pathogen load in the water line and equipment can jeopardize bird health.
8. **Poor ventilation:** respiratory/bronchitis challenges threaten immune function.
9. **Compromised immune function:** can reallocate carotenoids to the birds survival needs and lower the deposit of carotenoids into the yolk.
10. **Lighting:** directly impacts feeding behavior, feed intake, utilization and production.
11. **Abnormal intake:** both extremes of low and high daily feed intake may disrupt nutrient deposits in the egg as well as yolk color.

There are effective tools available to help achieve a desirable egg yolk color. Work closely with a Crystal Creek® nutritionist to develop a plan that is best for your operation to help reach your production, egg yolk color and profitability goals.

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Reducing Feed Shrink Can Increase Your Profitability



By Teresa Marker, B.S.

Feed costs, both farm raised and purchased, are usually the largest expenses on a dairy farm. In today's economy, finding areas of opportunity for extra profit has become more critical than ever before. Evaluating a

farm's feed waste/loss, commonly referred to as shrink, is an area that should be scrutinized. Shrink can have a significant impact on feed quality, quantity and profit. Silage shrink can range from 7-48% depending on a variety of factors, with 10-20% being typical. Reducing shrink on your farm will not only improve the inventory volume of feed but it will also help retain nutrients resulting in better nutrition and higher milk production and profit. Some basic steps to help reduce shrink on your farm are:

1. Properly maintain equipment and harvest at the correct dry matter percentage.
2. Use correct storage and packing techniques.
3. Maintain feed quality at feedout.

Properly Maintain Equipment And Harvest At The Correct Dry Matter Percentage

The first challenge of the harvest season is getting the feed off the field. There is a feed loss potential of 1-12% dry matter during the harvest. Hidden losses during this stage include feed that is left on the field due to inclement weather preventing proper timing of the harvest or feed left on the field due to failure of the harvest equipment itself. Examples of equipment or operator error could be: silage not getting picked up or the chopper not depositing the feed properly into the trucks or wagons.

If the weather conditions are cooperating and all machinery is working properly, the second step in preventing dry matter loss is to harvest at the right dry matter percentage. Forage that is too wet or too dry will not ferment properly and the quality and quantity of the feed will be reduced. The correct harvest dry matter percentage will ultimately depend on the storage structure the feed will be placed in. It is critical to make sure to perform routine moisture tests on the feed so that the feedstuff is harvested at the correct time.

Use The Correct Storage And Packing Techniques

It is important to properly pack and store the feed. Fermentation of silage results in a potential of 5-18% loss in dry matter and up to another 8% can be lost with effluent. The effluent is the liquid that is produced when ensiled crops have a high moisture content. The liquid starts to leak out of the silo shortly after the start of the fermentation process of the plant material. Use of the Crystal Creek® inoculant Inoc-U-Lock™ can help reduce dry matter loss during fermentation. The Inoc-U-Lock™ line of products uses a controlled fermentation approach to get feed to ferment faster so less dry matter, protein and quality is lost in the feed. Inoc-U-Lock™ is sold in either dry granules or a water-soluble powder. When a feedstuff goes through the fermentation process, it can naturally lose 5-18% of the dry matter that was harvested.

Figure 1 illustrates the percentage of dry matter that can be lost in storage. Using Inoc-U-Lock™ on your feedstuffs can reduce dry matter loss by 4%. This 4% dry matter savings is like having an extra 4 acres worth of feedstuff for every 100 acres of feed harvested. A good return on investment is achieved due to the additional dry matter available to feed. This return is based on dry matter savings alone and does not take into account the increased forage quality,

which can often lead to improvements in animal production and performance.

Figure 2 shows the return-on-investment for reducing dry matter loss by 4%. Typically forages and high moisture grains left to uncontrolled/wild fermentation could experience a dry matter loss ranging from 12 to 30%. Calculating a 4% reduction in dry matter loss when using Crystal Creek® Inoc-U-Lock™ products is a conservative estimate and supported by independent research.

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Figure 1 % DM LOSS FROM STORAGE

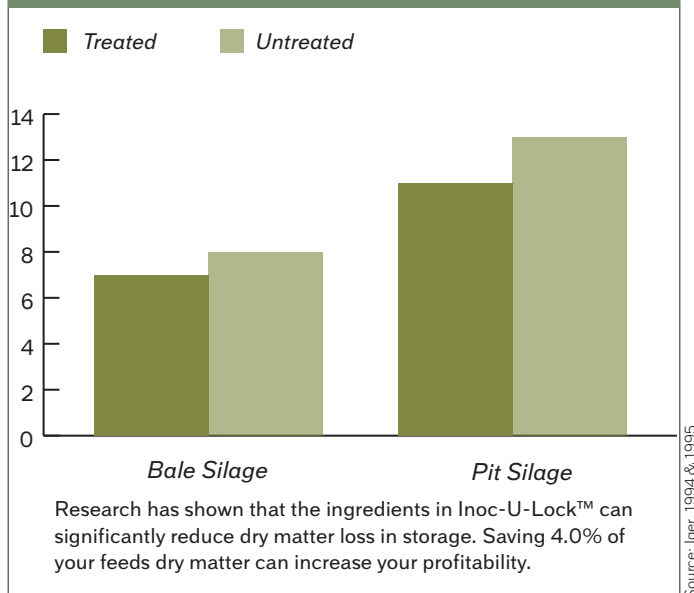


Figure 2 RETURN-ON-INVESTMENT WITH 4% REDUCED DRY MATTER LOSS

Ingredient	Tons Harvested/ Year	CONVENTIONAL		ORGANIC	
		Value/Ton	Total Value	Value/Ton	Total Value
Corn Silage	274	\$35.00/ton	\$ 9,590.00	\$55.00/ton	\$15,070.00
Haylage	456	\$70.00/ton	\$31,920.00	\$110.00/ton	\$50,160.00
HMSC	183 or 156 for dry shell corn* 35.7 lb./bushel	\$3.50/bushel*	\$19,500.00	\$14.00/bushel	\$78,000.00
*HSMC tonnage adjusted to dry shell corn equivalent valued at \$3.50/bushel		Total Feedstuff Value	\$61,010.00	Total Feedstuff Value	\$143,230.00
		Less 4% Shrink	x 0.04	Less 4% Shrink	x 0.04
		Lost Value	\$2,440.40	Lost Value	\$5,729.20

Conventional Value:

\$2,440.40
- \$1,188.85
\$1,251.55

Value of Lost Feedstuff
 Cost to treat with Crystal Creek® Inoc-U-Lock™
Savings/year when using Crystal Creek® Inoc-U-Lock™
R.O.I. = 2.05 : 1

Organic Value:

\$5,729.20
- \$1,188.85
\$4,540.35

Value of Lost Feedstuff
 Cost to treat with Crystal Creek® Inoc-U-Lock™
Savings/year when using Crystal Creek® Inoc-U-Lock™
R.O.I. = 4.82 : 1

Reducing Feed Shrink Can Increase Your Profitability

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The next potential factor attributing to dry matter loss is where and how the feedstuff is stored (the storage structure) and the packing density. A high percentage of feed can be lost if the storage structure is not air tight or if the feed is not packed well.

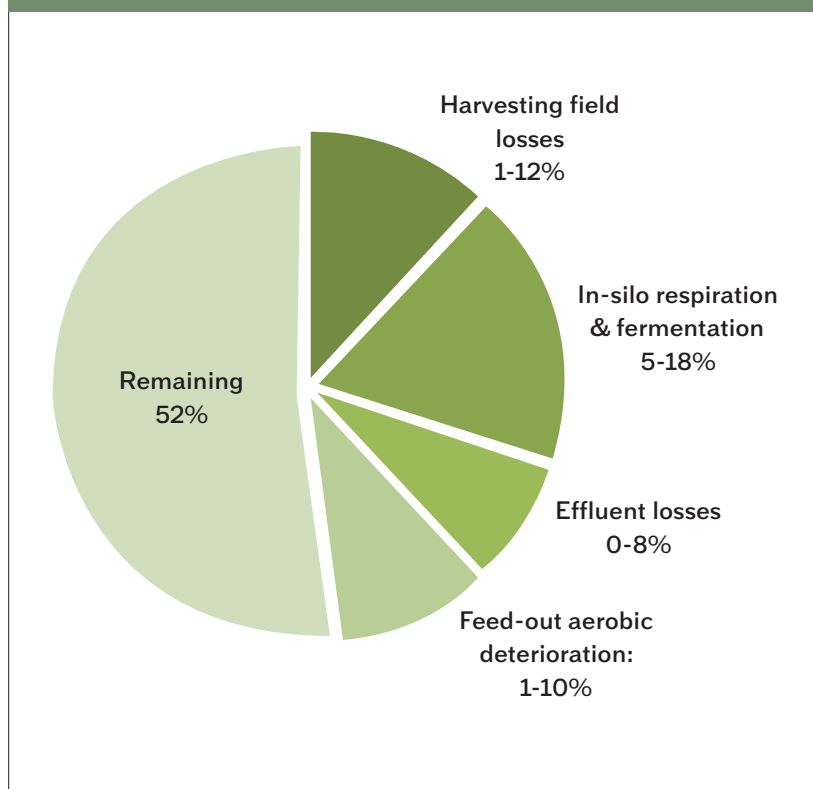
Maintain Feed Quality At Feedout

Dry matter loss at feedout can account for a 1-10% loss. Reducing dry matter loss at this stage can be as simple as using a facer on your silage bunkers or piles. Facers help reduce dry matter loss by evenly removing silage from the pile so that the face of the pile is left smooth without any jagged edges. Any feed that is exposed to air will be prone to waste. It is important to evaluate the TMR mixer function and process. Overfilled mixers spill forage over the top. It is not uncommon to see a forage trail to the barn if the mixer is overfilled. Have the TMR mixer evaluated on a regular basis to make sure that the scales are accurate and that moisture of feed is consistent with the ration provided by a nutritionist. Any variance in the scales or moisture can have a significant impact on the ration being fed.

Bunk management is one of the last steps in maintaining feed quality, but it is definitely not the least. The feed has made it from the field, through storage, mixing and finally to the cow. The cow would love to eat every bit of that feed so that she can produce high quality milk. Continually pushing up feed will help keep cows eating. If there is plenty of extra feed left at this stage, make sure to work with your nutritionist to get a balanced ration to ensure there is minimal weighback and the least possible wasted feed. A 2-3% weighback will assure cows have adequate feed with minimum waste.

Figure 3

POTENTIAL DRY MATTER LOSSES IN SILAGE PRODUCTION



Source: Institute of Grassland and Environmental Research, Aberystwyth, Ceredigion

The chart in Figure 3 shows the different potential dry matter losses in silage production. Losses can add up to almost 48% dry matter loss if they are not managed properly. This dry matter loss can have a significant impact on feed inventory and profit. For example: If haylage on your farm is valued at \$125/ton dry matter (approximately \$50/ton as fed), with a 48% shrink, true cost of that forage is actually \$240/ton dry matter (\$96/ton as fed).

A Crystal Creek® livestock nutritionist can be helpful in analyzing potential profit loss in your ensiling program. Most farms can strongly improve their profit margin by improving silage harvesting, storage and feedout. With good management, less silage shrink can be attained. It is critical to start evaluating silage shrink on your farm.



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Forage Digestibility: How It Affects Your Bottom Line



By Erik Brettingen, B.S.

Forages have traditionally been tested for Acid Detergent Fiber (ADF) and Neutral Detergent Fiber (NDF). While these values determine how much of each type of fiber there is, they do not give any information as to how digestible, or

actually useable, the fiber is to the cow. A more accurate measurement in predicting how well cows will perform on a particular forage crop would be Neutral Detergent Fiber Digestibility (NDFd) and Undigestible Neutral Detergent Fiber (uNDF). The digestibility of NDF is a critical piece of information for balancing rations to maximize cow performance, improve cow health, and minimize ration costs by relying on as much home-grown forages as possible.

Testing for NDFd

Forages can be measured for NDFd and uNDF through In Vitro, In Situ, and Near Infrared (NIR) analyses¹. In Situ analysis involves placing forage into a small bag and placing it into the rumen of a cannulated cow for a designated period of time. The amount of NDF present before being exposed to the rumen fluid is compared to the amount of NDF still present when taken out, therefore determining how much of the NDF is digestible. This process is not typically performed by commercial labs as it is not timely or practical. In Vitro analysis is more common. This is when rumen fluid is added to a forage sample along with a buffer for a period of time, usually 24, 30, or 48 hours. While more common, and used to double check suspect forages, this method is not typically used for routine samples either. There has been enough testing through both In Situ and In Vitro to develop accurate and consistent equations to be used with (NIR) testing. NIR is the testing method most commonly utilized by labs because of the speed and low cost of the test.

When forages are tested for NDFd and uNDF, the results are listed in various time points. For example, NDFd30, NDFd120, and NDFd240 and most typically uNDF30 and uNDF240. The numbers

correspond to the number of hours it would take that fiber to be digested, or the amount of time the fiber can be present and still be undigested. These time points are critical for nutritionists as they lay out the three pools of NDF in a forage; the fast digesting fiber, the slowly digesting fiber, and the indigestible fiber. The uNDF240 refers to fiber that is indigestible, even after 240 hours in the rumen. By determining these 3 categories of fiber, nutritionists are able to estimate the passage rate of the fiber through the rumen, how much of that forage a cow may be able to eat, and how well a cow will perform on that feedstuff.²

Cow Performance

Dry Matter Intake: The indigestible fiber in forages, uNDF240, is what creates a rumen mat and fills the rumen as more indigestible fiber is consumed. While a healthy rumen mat is needed, feeds that are high in uNDF240 will limit dry matter intake, potentially reducing dry matter intake. Many studies have been done, and while the optimal amount of uNDF240 always seems to be a moving target, the maximum amount of uNDF a cow can consume usually falls between 0.35% and 0.45% of the cow's body weight per day.

Milk Production: Forages that are more digestible are able to be consumed at higher quantities because forage pass through rates are faster and there is less indigestible fiber taking up space in the rumen. This increases dry matter intake, which in turn increases the entire nutrient amount the cow gets in a day. This is a huge benefit as dry matter intake can drive milk production. Rumen microbes also benefit from the highly digestible fiber. The microbes in the rumen should be considered the number one source of protein to the cow every day. This protein from the rumen microbes is known as microbial protein. To maximize microbial protein, rumen microbes need Rumen Degradable Protein (RDP) and fermentable carbohydrates. One of the best sources of fermentable carbohydrate for the rumen is digestible fiber. When more digestible fiber is present, generally the rumen needs less starch and sugar to perform.

NDF digestibility can vary greatly. According to Dave Combs from UW-Madison, the digestibility of the NDF in average quality, alfalfa-based forage can vary from 30 to 60 percent. In a diet containing a moderate amount of this feed (15 lb. of dry matter) this change in digestibility could account for 8-10 lb. more milk³. With a current base price of \$19.01⁴, an average of 9 additional lb. per day, creates a potential increase in revenue of \$1.71 per cow per day. Focusing on digestibility pays!

Milk Components: Improving milk volume is not the only area fiber digestion can be a positive influence. Fiber digestion drives the production of acetic acid and butyric acids. These volatile fatty acids are responsible for producing butterfat in the udder and ultimately provide about half the butterfat present in milk. Increasing fiber digestibility results in an increased production of butterfat. The other fatty acids used for butterfat production can originate from the diet or from mobilization of body tissue⁵. While fiber digestion drives fat production through acetic and butyric acid, the highly digestible NDF also feeds the rumen microbes. These rumen microbes turn the dietary protein into the perfect package of amino acids for milk and milk protein synthesis. Rumen microbes utilize the highly digestible and highly fermentable NDF, as well as carbohydrates, like the starch from corn and dietary sugar, to maximize the protein that is degraded in the rumen and turn it into protein for the cow.

Cow Health

Ruminants thrive on high forage rations to support rumen function and overall animal health. When forages that are high in NDFD are fed, more forage can be consumed and cow performance can be sustainably supported. This ration strategy of feeding higher forage diets supports cow health and decreases the risk of many potential health issues like displaced abomasums, laminitis, and sub-acute rumen acidosis.

Ration Cost

When forage NDFd is low, ration costs inherently increase. Cows will not perform as well without increased supplementation. With less digestible fiber, cows need more fermentable carbohydrate, usually supplemented as corn, or sometimes a non-forage by-product like soy hulls or corn gluten feed in an effort to generate similar energy and microbial protein from the diet. This requires the purchase of off the farm feedstuffs and often affects ration effective fiber, decreasing the potential for a cow friendly ration. Along with fermentable carbohydrate, by-pass forms of protein often need to be increased to make up for the amount of lost microbial protein through lack of digestibility. These by-pass protein sources, like heat treated soybean products, quickly increase ration cost and often do not make up for a poor-quality forage.

Evaluating the digestibility of the forages on your farm could be a key to increasing your herd's performance and limiting your out of pocket expenses. Digestibility of forages should be tested by a licensed lab to determine which forages fit best in your rations and at what levels they can be fed. While testing for NDFd and uNDF is a critical first step, the information gained needs to be used properly to optimize the ration and improve profitability. Contact a Crystal Creek® nutritionist to learn how fiber digestibility can be used to maximize the profit on your farm.

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Maximizing Equine Reproductive Performance: Reducing the Impact of Summer Stress



By Alex Austin, B.S.

While many horse owners have horses as a hobby for enjoying the occasional fun show or trail ride, there is a business side to the equine industry as well. Horse racing, polo, and competitive jumping are just a few different segments that make up the

diverse economy of the horse world. According to the American Horse Council Foundation's 2017 National Economic Impact Study, the equine industry contributes approximately \$50 billion to the U.S. economy annually and helps create 988,394 jobs¹.

Equine breeding facilities focus on raising foals that have potential to become superior equine athletes. The success of a breeding facility depends on the performance of the foals they produce. Success starts with the pairing of a stallion and a mare. Many factors can affect whether the mare becomes pregnant and has a healthy foal that will reach its full genetic potential. Over the course of the next three newsletters, Crystal Creek® will be taking an in-depth look at how summer/heat stress, nutrition and biosecurity considerations can affect equine reproductive performance.

This article will discuss the impact summer/heat stress can have on equine reproduction and the tools Crystal Creek® has available to help minimize summer stress' negative effects.

Effect of Heat Stress

Heat Stress is defined as "an environment that acts to drive body temperature above a set-point temperature ²." Breeding facilities commonly keep horses in stalls. Stalls are a great option when horses need to be separated but they can also be hot, have reduced air quality and have increased fly pressure. All of these factors cause additional stress to the horse.

The breeding season can be a very stressful time for both stallions and mares. Transporting horses to and from breeding facilities and performing artificial insemination procedures can all impact the reproductive performance of the horse.

When evaluating a stallion's reproductive performance, it is important to remember that sperm are very sensitive to temperature. To keep sperm viable, they must be maintained at 3-4 degrees below body temperature. Prolonged exposure to elevated temperatures can cause sperm abnormalities, dysfunction and even death. The effect of heat stress on sperm quality can be evident within a few days and can last as long as 70 days³.

Mares can also be impacted by heat stress. Environmental and exercise induced heat stress can both have negative effects on ovulation. Extended exposure to environmental heat stress with elevated temperatures and increased humidity can cause a decrease in embryo quality. Studies show mares that experience exercise induced heat stress have a significantly lower embryo recovery rate compared to non-exercised mares³.

Crystal Creek® Summer Equine Stress Solutions

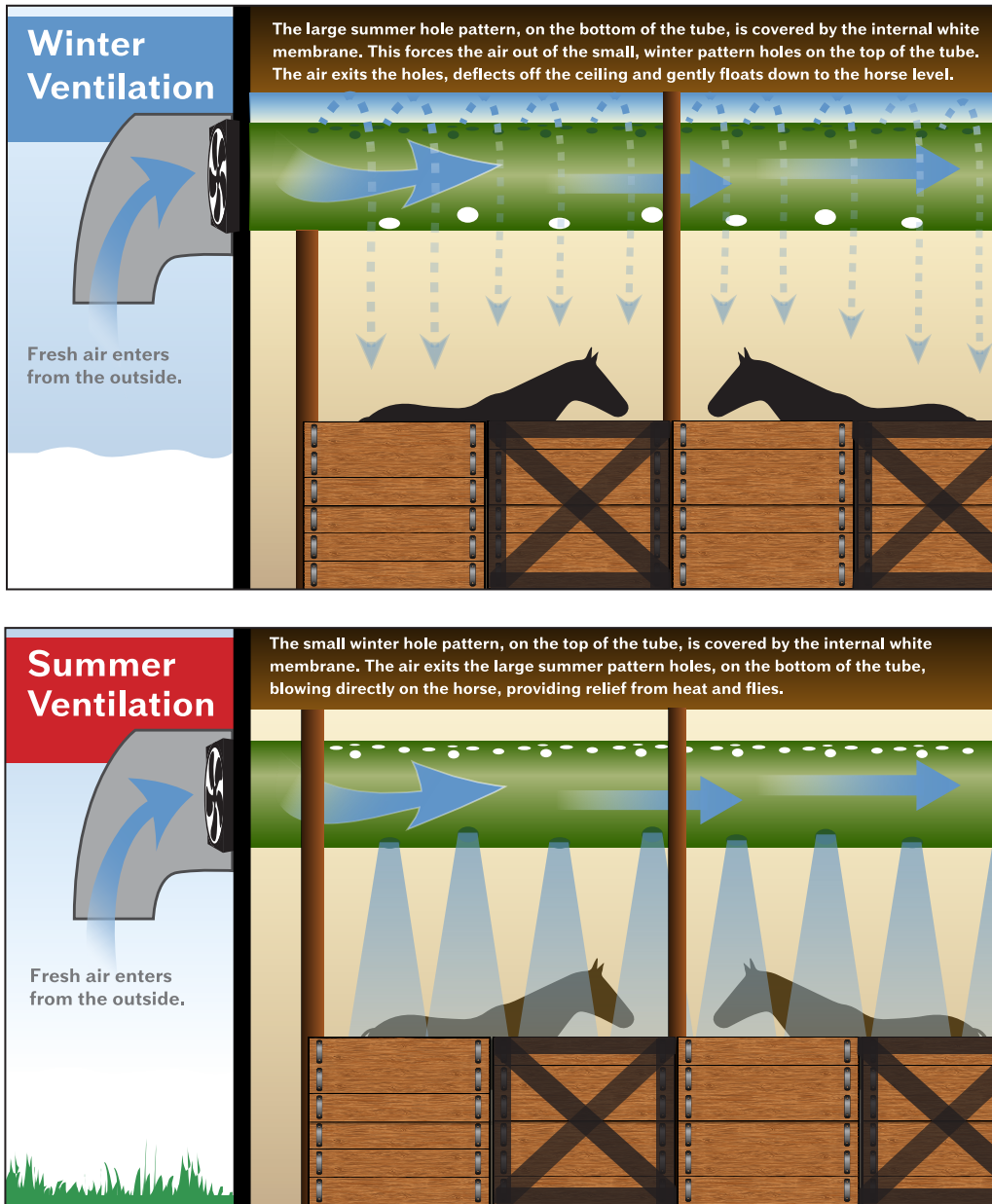
Ventilation

Proper ventilation should be utilized for heat abatement, improving air quality and reducing fly pressure. Prolonged periods of heat stress can cause dehydration, heat stroke, muscle dysfunction and even colic. While ceiling and box fans can provide air speed for some heat abatement, they do not improve air quality inside the stall.

Reducing moisture/condensation levels, dust and air particles, ammonia content, pathogens and odor contamination are all key to improving air quality. The Crystal Creek® FLAP DUCT® ventilation system can address all these areas of need with one system.

Figure 1

ILLUSTRATION OF HORSE STABLE



Penn State recommendations for air exchange rates, air volume and air speeds in equine facilities are as follows:

Air Exchange:

Provide a minimum of 4 to 8 air exchanges per hour⁴

Air Volume:

Provide a minimum of 25 cfm per 1,000 pounds of body weight

- a. 100cfm during spring and fall seasons⁴
- b. 200 to 350 cfm during the summer season⁴

Air Speed:

Provide

- a. 200 to 600 feet/minute for fly control and heat abatement during the summer season⁵
- b. ≤ 50 feet/minute for non-drafty air during the winter season⁵

When using the Crystal Creek® FLAP DUCT® ventilation system, we are able to meet, and even exceed, these requirements. FLAP DUCT® is able to provide fresh air year-round and can easily be adjusted to control the speed and volume of the air no matter what the season. FLAP DUCT® can be paired with a heating system for stables in the

winter season and even automated for greater ease of use. The ability to reduce heat stress and provide a more comfortable environment for the horse can have a positive impact on the horse's overall well-being and the entire reproductive cycle.

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Fly Control

Flies are known to spread disease, cause stress and agitation, and leave swelling and inflammation from their painful bites. Flies can be an irritating physical annoyance but they can also cause animals to become distressed to the point of interfering with animal health and performance. A constant high exposure to flies can elevate an animal's stress level causing a chronic exposure to cortisol, eventually resulting in a decreased immune function. Using an effective fly repellent is crucial during the reproductive process to minimize the effects of stress created by fly pressure.

Crystal Creek® Crystal Advantage® Equine Fly Repellent is a natural, economical tool that provides safe, effective relief from flies. A recent efficacy trial using the Crystal Creek® Crystal Advantage® Equine Fly Repellent produced an 87% fly repellency rating and performed particularly well repelling stable flies, who are known to be very aggressive. Anytime a fly repellent scores above a 70% repellency rating, it is considered an effective product. Crystal Creek® Crystal Advantage® Equine Fly Repellent can be used as a spray or wiped on for more sensitive areas such as the face and ears. It is available in a ready to use

32 oz. spray bottle or a concentrated 32 oz. bottle that can be diluted with water at a 1:1, 1:2 or 1:3 ratio. In addition to an effective fly repellent, it is important to use other fly control methods such as keeping the facility clean of manure and other waste, dumping out stagnant water and disposing left over feed to discourage areas flies may be attracted to.

Nutritional Support

Providing high quality nutrition is extremely important to give stallions and mares the greatest probability of reproducing. Once conception takes place, the mare will need a ration that provides for additional nutritional requirements above maintenance levels due to fetal growth. Crystal Creek® Crystal Advantage® Equine Mineral is a highly bioavailable source of minerals and vitamins that help support immune health, endurance, and overall performance. The chelated minerals used in the Crystal Creek® mineral line are shown to be over 90% available to the animal.

Crystal Advantage® Digestive Support is a pelleted supplement that can be used in addition to the Crystal Advantage® Equine Mineral during times of extra stress or transition. This product is used strategically to help manage the negative impacts stress can have on equine performance. It is designed to be fed a week before, during and after a stressful event (such as breeding). For chronic/ongoing issues, Crystal Advantage® Digestive Support can be fed daily for longer periods of time.

The naturally derived ingredients in Digestive Support have been scientifically proven to:

1. Stimulate the immune system along the gastrointestinal tract
2. Decrease inflammation by selective COX-2 inhibition
3. Promote nutrient absorption in the lower gastrointestinal tract



Crystal Advantage® Digestive Support contains aloe and cumin, which have research supporting their effectiveness for anti-inflammatory effects. Aloe has been shown to support both immune function and digestion during times of stress or challenge.⁶ Cumin acts as an anti-inflammatory, as well as an antioxidant. Research supports cumin is effective against neurological problems such as anxiety.⁷ Reducing the negative impacts of stress on a horse is another great tool that can improve overall reproductive performance.

Stress can affect horses in a number of different ways. Crystal Creek® has tools to help. When stress is reduced, it can have a positive impact on equine performance, including reproduction. For more information on effective stress reducing methods for your horses, contact Crystal Creek® today.

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CRYSTAL CREEK® FOUNDATION GRAIN MIX

A texturized grain mix of corn, oats, roasted soybeans and molasses formulated so you can add the appropriate amount of Crystal Creek® mineral based on your individual animal's needs.

- 16% Protein
- High quality ingredients, economically priced
- Flexibility for use in multiple species
- Promotes improved performance resulting in increased feed efficiency and greater return on investment
- Easy to mix
- Supports endurance and production during times of challenge





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