

Feed Additive Evaluation Guidance for Enteric Methane Mitigation

Through consistent, iterative and focused evaluation, the U.S. dairy value chain can work collaboratively to transform feed additives from promising options to real-world solutions for enteric methane reduction in dairy cattle.

Table of Contents

3. WHY Feed Additives Matter for Methane Reduction
4. WHY Feed Additive Guidance Matters
5. Value of Project
6. Our Approach
7. Our Methodology for Value Chain Conversations
 - Participants Represent the Full Value Chain
 - A Focus on Four Topics
 - Participants Prioritized and Ranked the Four Topics
 - Topics and Insights
 - Safety
 - Efficacy
 - Potential Trade-offs & Benefits
 - Adoption
32. Evaluation Tool for Enteric Methane Mitigation with Feed Additives
38. Best Practices & Research Gaps
41. Contact



WHY Feed Additives Matter for Methane Reduction

Enteric methane is a major contributor to greenhouse gas emissions by dairy cattle. The inclusion of feed additives in dairy cattle rations to improve feed quality or animal health and performance is already a routine practice in farms of all sizes. Feed additives that reduce enteric methane as their primary or secondary benefit matter because they provide practical options to mitigate those emissions.

Encouragingly, the scientific evidence for feed additives that mitigate enteric methane emissions from dairy cattle is growing exponentially with new information available almost every week.



AN EMERGING SOLUTION

WHY Feed Additive Guidance Matters

While feed additives are emerging as a promising method for mitigating enteric emissions from dairy cattle, evaluating the additives given their varied attributes presents a challenge. No two feed additives are alike, and the scientific evidence of safety, efficacy, access, and cost/benefit available on them varies widely.

The U.S. dairy value chain consists of multiple stakeholders with various perspectives regarding the complex issues of enteric methane emissions from dairy cows. Successful use of feed additives at-scale requires them to meet dairy farm objectives while satisfying needs and expectations from the other dairy supply chain stakeholders and the consumers they serve.



AN EMERGING SOLUTION

Value of Project

Dairy Management Inc. hosted 20 facilitated dialogues with U.S. dairy industry experts across the value chain. Through these conversations, we examined the "wish list" of desired attributes important to transform feed additives from proof-of-concept into marketable best practices for enteric methane emission reduction.

This report summarizes what we learned into **12 insights** that were used to develop an **evaluation tool** to assist dairy farmers, their trusted advisors and other dairy value chain stakeholders in asking the right questions to evaluate the use of feed additives for enteric methane mitigation.

The report also highlights barriers to broad adoption, **existing best practices** and opportunities to develop **new best practices**.



Our Approach

Our process looked to engage key stakeholders and translate essential insights into a guidance tool to aid in decision making. The process included one-hour facilitated conversations with 20 value chain leaders representing different perspectives.

Guided by a series of open-ended questions, the mission was to encourage candid dialogue, listen and learn from different perspectives. We sought to identify and understand needs, commonalities and gaps across the value chain that must be addressed to gain adoption of enteric methane mitigating additives as a solution:

1. Collect feedback on criteria to evaluate feed additives for enteric methane reduction.
2. Define questions farmers and their trusted advisors could use to fully understand each feed additive option and make sound, educated decisions for their unique, on-farm use.
3. Gain a deeper understanding about the perceived barriers, benefits and trade-offs that will help the value chain collaborate to advance, adopt and bring to market feed additive solutions to reduce enteric methane emissions.



Our Methodology for Value Chain Conversations

GOALS

Participants Represent the Full Value Chain

All participants were invited based on their expertise, thought leadership and role in representing the different perspectives across the dairy full value chain, including the following:

- Farmers
- Dairy cooperatives
- Dairy processors/brands
- Trade associations
- Non-governmental organizations (NGOs)
- Feed additive companies
- Academics and research experts
- Veterinarians



Todd Armstrong, PhD
*Vice President,
US Ruminant Business
Phibro Animal Health*



David Darr
*Chief Sustainability Officer,
Vanguard Renewables
(at time of interview)
Sr. Vice President & Chief
Sustainability Officer, DFA*



Jed Davis
*Vice President, Strategic
Engagement/Sustainability
Agri-Mark/Cabot Creamery*



Nicolas DiLorenzo, PhD
*Professor, Animal Science
University of Florida*



John Frey
*Director, Dairy Dev.-Value Chain
Phibro Animal Health*



Krysta Harden
*President & CEO
U.S. Dairy Export Council*

Value Chain Participants



Alex Hristov, PhD, PAS
*Distinguished Professor
Dairy Nutrition
Penn State University*



Scott Hutchins, PhD
*Adjunct Professor
University
Nebraska-Lincoln*



Jamie Jonker, PhD, DVM
*Chief Science Officer
Vice President Sustainability &
Scientific Affairs
The National Milk Producers
Federation*



Emily Johannes
*Head of Sustainable
Sourcing
Nestlé USA*



Chris Kopman
*General Manager
Newtrient*



Tim Kurt DVM, PhD
*Sr. Vice President
Environmental Research, DMI
(at time of interview)
Foundation for Food
& Agriculture Research*



Frank Mitloehner, PhD
*Professor & Air Quality
Extension Specialist
UC Davis*



Roberta Osborne, PAS
*Director Farms &
Sustainability
Chobani*



Dan Peerless
*Global Sustainable
Sourcing Lead
Nestlé*



Partha Ray, DVM
*Sustainability &
Animal Scientist
The Nature
Conservancy*



Joan King Salwen
*CEO
Blue Ocean Barns*



**Mark van
Nieuwland**
*VP Bovaer®
DSM Nutritional
Products*



Suzanne Vold
*Dorrich Farms, Glennwood, MN
Environmental Stewardship
Committee
Innovation Center for US Dairy*



Peter Williams
*Agolin Manager
Agolin Ruminant Dairy &
Feedworks USA*

A Focus on Four Topics

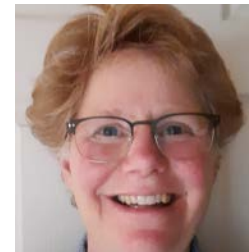
To solve the industry's feed additive puzzle, four crucial pieces were identified:

1. Safety
2. Efficacy
3. Trade-offs and Benefits
4. Adoption

To ensure consistency, each facilitated conversation was guided by a script, PowerPoint and identical series of open-ended questions pertaining to each topic. At the end of the conversation, each participant was asked to prioritize the four topics by order of importance to their business.



Conversations led by:



Mary Beth de Ondarza
*3rd Party Facilitator
Nutritionist
Paradox Nutrition, LLC*



Juan Tricarico, PhD
*Project Lead & Presenter
Sr. V.P. of Sustainability Research
Dairy Management Inc.*

Participants Prioritized and Ranked the Four Topics for Evaluating Feed Additives for Enteric Methane Mitigation in This Order



1

Safety for Cow +
Consumer



2

Methane
Reduction
Efficacy



3

Potential
Trade-offs
and Benefits



4

Community
Adoption

Safety

for Cows and Consumers



What evidence do you need to be convinced that a feed additive is safe?



Insight 1

Animal and Food Safety Are Nonnegotiable

Animal and food safety contribute directly to consumer trust in dairy foods. Animal and food safety are therefore not negotiable. This requires evidence that the concentrations of potential residues in milk and meat resulting from feeding an additive are within levels determined to be safe for their consumption.

When experts were asked about what evidence they needed to be convinced that a feed additive is safe for cows, humans and the environment, they agreed that lack of animal and food safety is a deal-breaker for all participants across the entire value chain.

"We shouldn't even have the conversation if there isn't certainty at the highest level that a product is safe."

*John Frey
Phibro Animal Health*

“

Safety is most important to me – for consumers and cows – because we produce a food product and we work with living beings. As a farmer who produces a product for human consumption, I would never even dream of considering them if they weren't safe. Health has to come first."

*Suzanne Vold, Dorrich Farms
Glennwood, MN*

"Safety to cow and consumer is primary. It has to be 100%"

*Partha Ray, DVM
The Nature Conservancy*

Insight 2



Safety Is Based on Composition and Conditions of Use

Safety is confusing to the public for good reason. Although FDA has the responsibility for regulating the use of animal food products, the ultimate responsibility for producing safe and effective animal food products lies with the manufacturers and distributors of the products.

While premarket review and approval by FDA is considered by many as a "requirement" for establishing the safety of a feed additive, there is a GRAS (generally recognized as safe) exception. A feed additive may be identified as GRAS if it has been adequately shown among a group of qualified experts to be safe under conditions of its intended use.

The FDA vs GRAS "safety" designations are complicated by two key factors:

1. The FDA process is time-consuming and expensive.
2. GRAS has created a common misperception that compounds found in nature are safe and require no evaluation.



U.S. dairy leadership needs to 'plant the flag' regarding proof of product efficacy and safety because our farmers should not be asked to use products of dubious efficacy or, even worse, having potential safety issues."

*Jamie Jonker, PhD, DVM
National Milk Producers Federation*

"Careful research is needed even for 'natural' additives because they may contain carcinogenic or toxic compounds. For example, we know that a whole list of natural, essential oils can be toxic depending on the dose, not just to microbes but also to higher life."

*Alex Hristov, PhD, PAS
Penn State University*



Insight 3

Safe Ingredient Handling Is Important

Worker safety is vital to feed manufacturers, farmers and milk processors. Instructions for safe ingredient handling are required and must be clear/understandable.

“Safe handling goes beyond the farm to the production, distribution and use of the material (feed additive) itself.”

*Tim Kurt, PhD
Formerly FFAR*



It’s got to be good for cows and humans. And it also needs to be safe to handle. What’s the safety consequences of manufacturing this stuff? We want to look at that. What is it going to do?”

*Roberta Osborne, PAS
Chobani*

“The definition of safe handling should include animal, human, worker and environmental safety.”

*Mark van Niewland
DSM Nutritional Products*



Safety is the Foundation for Confidence

Confusion

“What concerns me is that companies can just say, ‘Our additive is GRAS because we declared it as such.’ ... And everybody thinks it's fine.”



*Roberta Osborne, PAS
Chobani*

Reputation

“We can accept varying degrees of methane reduction efficacy, but if one additive in the market has a safety issue, the whole category could be removed from the market.”



*Dan Peerless
Nestlé*

Confidence

“It's very important that we don't lose consumer trust and confidence in what we do.”



*Frank Mitloehner, PhD
UC Davis*

Efficacy

for Methane Reduction



What evidence do you need to be confident that a feed additive is effective?

Insight 4

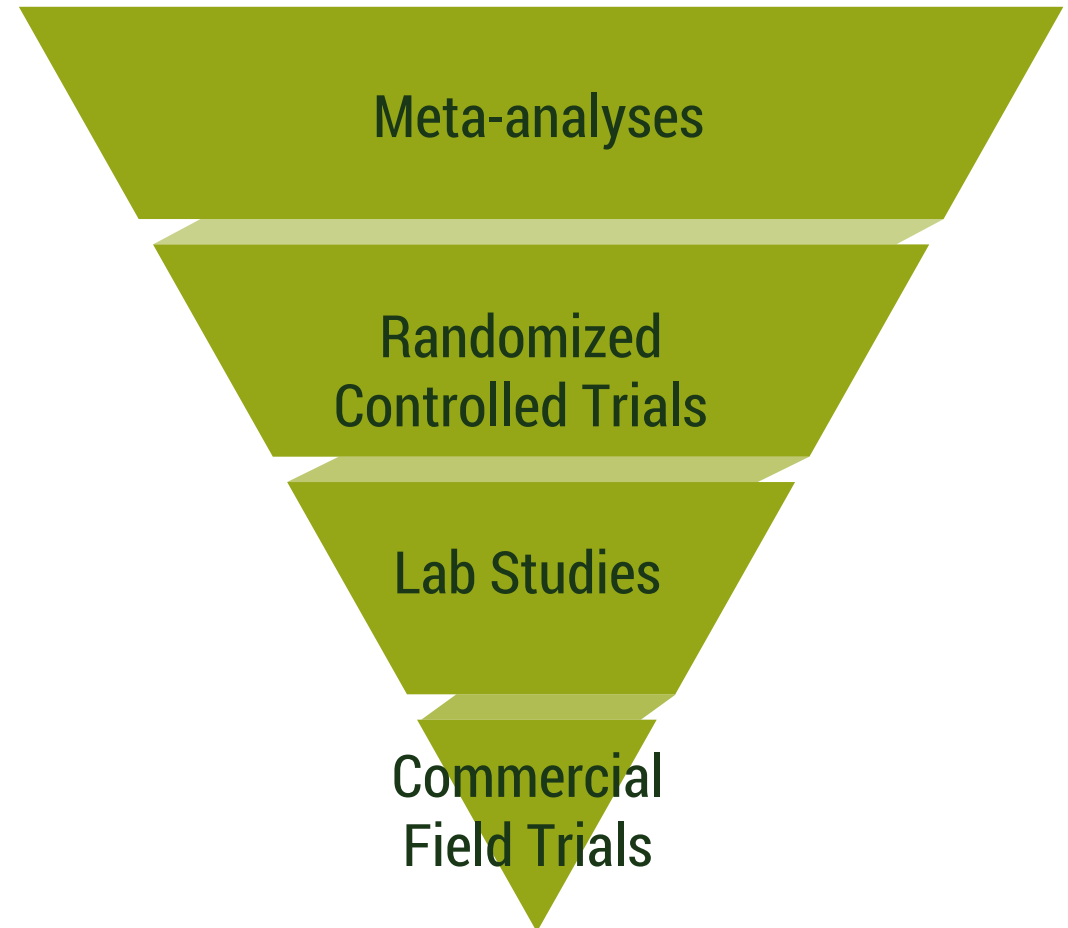
Confidence Depends on the Collective Body and Quality of Evidence

The level of confidence on the expected methane reduction depends on the collective body of evidence following scientific rigor and clearly defined conditions of use.

The scientific rigor of the research is vital, including correct study design and statistical analysis, accurate techniques for methane measurement, and publication in a peer-reviewed journal.

Defined conditions of use – dose, duration of feeding and a complete description of diet, management and environment – are essential to confidently predict mitigation effects.

A reliable body of evidence is required for all feed additives, regardless if they are synthetic or processed ingredients or made from natural extracts.



How confident are you about the reduction?

Insight 5

All Study Types Play a Role in Evaluation

All study types contribute to building public confidence in a feed additive and must be part of a reliable body of evidence that is relatable to stakeholders including expert advisors like nutritionists and veterinarians.

Efficacy defines the expected effects under ideal (controlled) conditions.

Effectiveness defines the expected effects under commercial (real-world) conditions.



Meta-analysis synthesizes the body of evidence and relies on input studies.

Meta-analyses
reliant on the other pieces of evidence

Randomized controlled trials provide the evidence basis for “efficacy” and help define conditions of use.

Randomized Controlled Trials

Lab studies are useful screening tools to provide evidence on explanatory biological and biochemical mechanisms (mode of action or “how” the reduction occurs).

Lab Studies
includes in-vitro + mechanistic

Commercial field trials provide measures of “effectiveness” that are relatable to farmers and value-chain stakeholders.

Commercial Field Trials



Insight 6

Re-evaluation Must Be Ongoing as Evidence Builds

Continuous re-evaluation of feed additives is needed so dairy farmers and their trusted advisors can adjust the dairy farm's management recommendations as the body of evidence grows.

"For the scientist, it is important to evaluate the overall research trajectory of a particular feed supplement."

*Nicolas DiLorenzo, PhD
University of Florida*

“

To make a recommendation, I like to see peer-reviewed papers - and not just one. I want to see several peer reviewed papers ... and then I would like to see that this additive is tried under commercial conditions."

*Frank Mitloehner, PhD
UC Davis*

"If there's limited research right now, let's start with that, and then be comfortable adjusting over time as new information comes in."

*Chris Kopman
Newtrient*

All Types of Studies Matter

Control

“Controlled trials are the gold standard if they are performed by appropriate scientistsI do think we need that quality of evidence for every single additive that we are evaluating.”



*Joan King Salwen
Blue Ocean Barns*

Repeat

“You are looking for a body of evidence that ... you can repeat, is a standard, and you can follow up with a field trial.”



*Scott Hutchins, PhD
Formerly Under Secretary of Ag*

Communicate

“We need to communicate the benefits to audiences that are not going to review the scientific evidence.”



*Dan Peerless
Nestlé*

Potential Trade-offs & Benefits



How should potential trade-offs be addressed?

Insight 7

Milk's Economic Attributes Must Be Protected

Meeting food demand with a consistent and reliable supply of high quality, nutrient-rich milk and dairy foods remains the industry's top priority. Along with that, maintaining animal health and well-being are crucial. Feed additives that reduce enteric emissions, therefore, should minimize any potential negative impacts on:

1. Milk production, composition, nutritional value, and sensory attributes like flavor, consistency and aroma
2. Cow health as it relates to: feed or dry matter intake, body weight and condition, nutrient digestibility, reproduction, excretion, manure composition, and its fertilizer value

Potential benefits of feed additives on other animal metabolic functions, like improved dairy cow reproduction, must be evaluated.



"Milk and component consistency, as well as meat residues, are no-go tradeoffs. For instance, you can't make milk have an off-flavor."

*Jed Davis
Agri-Mark/Cabot Creamery Cooperative*



It is paramount that we still have reliability in the makeup and volume of milk that we've contracted. Those are imperatives. They cannot change. Methane reduction cannot come at the expense of diet and nutrition because that does affect the milk components."

*Emily Johannes
Nestlé*

"It is extremely important that whatever we feed has zero impact on the product quality.... And, with quality, I mean everything from taste and smell to nutrient profile."

*Frank Mitloehner, PhD
UC Davis*

Insight 8

Dairy Farm ROI Is a Priority

A positive return-on-investment (ROI) for dairy farmers is an economic priority.

The dairy value chain needs to examine and test potential long-term compensation systems through:

1. Short-term testing via cost-share across the value chain or government
2. Market premiums
3. Ecosystem services marketplace (carbon credits)

Various stakeholders believe that cost-sharing programs are valuable for feed additives without direct production benefits but can't sustain long-term farm profitability. Therefore, long-term positive ROI for dairy farms should come from supply chain partners marketing low-methane milk at a premium price and from ecosystem services marketplaces that directly monetize the environmental benefits that feeding additives provide.



"Emerging carbon markets is where the business case is and what is going to make the economics make sense for dairy farmers."

*Chris Kopman
Newtrient*

“

Return on investment is a priority at the farm-level. They (farmers) want to know: What's this going to cost me? What's it going to do to milk production? What's it do to my components? And, how's it going to impact feed?"

*David Darr
Formerly Dairy Farmers of America*

"A product has to be able to demonstrate that it actually will give a financial benefit to the dairy... Just because you reduce methane does not mean you're going to improve performance.... Certainly we need trials that are going to demonstrate overall benefits for dairy farmers."

*Peter Williams
Agolin*

Insight 9

Understand Market Value, Who Contributes and Who Benefits

The value chain must understand the economic value that can be realized from methane reductions and who within the value chain contributes to its creation.

- What are the economic values and costs associated to producing and marketing low-methane milk and dairy foods or carbon credits?
- What contributions are necessary by whom along the value chain to market low-methane milk and dairy foods or carbon credits produced with feed additives?
- How are the economic value and costs incurred for marketing low-methane milk and dairy foods or carbon credits distributed across value chain contributors?



“One of the biggest trade-offs that the value chain must address is: who is going to pay and who is going to realize the value? As of today, that’s not answered.”

*Todd Armstrong, PhD
Phibro Animal Health*

“

So, who gets the carbon credit? If it is being claimed by the (food) company, can the farmer claim it, too? ... I think we're going to be wrestling with that as an industry to try to figure that out.”

*Krysta Harden
USDEC*

“If it’s truly something that’s valuable to society, ultimately it will be economically sustainable in a rational free market enterprise system. Unfortunately, social shifts must find their way into the market but that’s usually on a time frame that’s not conducive with people who want to make changes fairly quick.”

*Scott Hutchins, PhD
University of Nebraska-Lincoln, former USDA Deputy Under Secretary*

Benefits and Trade-offs Build the Economic Case

Revenue

“Looking at each practice singularly makes it seem like nothing is working out, but looking at how the trade-offs from multiple revenue streams [milk and carbon markets] contribute to whole-farm profitability is how we figure this out.”

Emily Johannes
Nestlé

Value

“Society should compensate the farmer, if enteric methane mitigation is so important to them.”

John Frey
Phibro Animal Health Corp.

Reality

“There are very few magic beans in the world, especially when it comes to decarbonizing the atmosphere. Very often there are trade-offs.... Absolutely no (environmental) impact is an unfair standard, because we would never do or try anything to reduce carbon.”

Joan King Salwen
Blue Ocean Barns

Adoption

By the Dairy Community



What will it take to get the dairy community to embrace a feed additive for methane mitigation?



Insight 10

Adoption Is Challenging

Adoption is challenging because individual actors within the value chain differ on what they are willing to accept in terms of:

- Safety
- Efficacy
- Trade-offs and Benefits

Other practical implementation barriers such as feed additive availability, distribution and ease of use also impact the adoption process.

“Ease of access to new revenue streams is a barrier. Selling carbon credits is something new that farmers have to learn to capture revenue from methane reductions.”

*Chris Kopman
Newtrient*



Adoption may be the last thing that we figure out because it is so poorly understood and difficult to predict.”

*Tim Kurt, PhD
formerly FFAR*

“It’s very difficult to work through the system. We are providing product for free. We have nutritionists and farmers aligned and for reasons I can’t figure out we are still struggling to get adoption.”

*Emily Johannes
Nestlé*



Insight 11

Three Key Factors Drive Adoption

Widespread adoption seems to depend on the following three factors:

1. The ability to claim enteric methane reductions with confidence
2. The ability to market those reductions directly through carbon credits or through premium food products in the marketplace in simple and relatable terms
3. Consumer endorsement of the mitigation option and willingness to pay for their use

“For consumers, we need to simplify the message, put them at ease and give them confidence that this product is safe and good.”

*Krysta Harden
USDEC*

“

For each potential eCH₄ mitigation supplement, dairy producers and their advisers need to be able to answer, Is there a body of evidence that is reviewed by an entity that I trust?”

*Mark van Niewland
DSM Nutritional Products*

“Widespread acceptance is important for widespread adoption... research, nutritionists, dairies, consumer goods, and consumers all need to accept the product.”

*Peter Williams
Agolin*

“I am not sure I would call it consumer acceptance but consumer endorsement.”

*Scott Hutchins, PhD
Former USDA Deputy Under-Secretary*

Insight 12

Adoption Requires Full Value Chain Collaboration

Collaboration across the dairy value chain is required for alignment on the following:

- Scientific consensus on evidence (safety, efficacy and trade-offs) without cutting corners that compromise research integrity
- Collaboration between natural and social science to address the attitude and behavioral factors of technology adoption
- All segments of the supply chain collaborating to co-create viable adoption strategies that include sharing the economic value creation realized through premium pricing and/or environmental service markets
- Education and training for farmers and others in the value chain to help them decide between available mitigation options



“

Farmers are frustrated by the lack of enteric emissions measurement. Currently at the farm-level, we are just measuring how much additive was fed and how many cows ate it.”

Jed Davis

Agri-Mark/Cabot Creamery Cooperative

“If you want to achieve the highest possible impact, you’ve got to match social science with natural science. We need a representative from every segment of the supply chain in this journey of co-creation and co-development to build approaches of promoting or increasing adoption rate of new feed additives.”

*Partha Ray, DVM
The Nature Conservancy*

“It’s a rush to achieve a competitive position. Leadership will be very important. There’s high demand for feed additives to do two things: make a difference in the global community and help tell the story.”

*John Frey
Phibro*

Clarity and Motivation Empower Adoption

Collaboration

“Industry-wide collaboration is vital to adoption. From farmer to processor to NGO, collaboration and agreement will drive adoption.”

Jed Davis, Agri-Mark, Cabot Creamery Cooperative

Clarity

“What words you use to tell the feed additive story matters. This is not simple stuff, science never is. So, you have to think carefully about what words you use. Create a conversation that is easy for them to understand and visualize.”

*Krysta Harden
U.S. Dairy Export Council*

Motivate

“For dairy producers, a lack of knowledge on potential economic opportunities as well as ease of access to carbon markets could limit adoption of enteric methane mitigation supplements.”

*Chris Kopman
Newtrient*



Evaluation Tool for Enteric Methane Mitigation with Feed Additives

Applying What We Learned

Using the Tool

How the Tool Helps

This tool was developed to assist dairy farmers, their trusted advisors and other stakeholders in the dairy value chain in asking the right questions to evaluate the use of feed additives based on safety, efficacy and their benefits and trade-offs.

How to Use the Tool

Follow these steps to fill out questions regarding safety, efficacy and potential trade-offs and benefits:

1. Answer the questions to the best of your ability and write the corresponding score in the point section.
2. Once you have answered the questions, tally up the total points.
3. Reference the legend in each section to determine if the feed additive meets your required standards for usage.

Tool Results

Gain a deeper understanding of the perceived barriers, benefits and trade-offs that will help the U.S. dairy value chain work together to advance, adopt and bring to market feed additive solutions to reduce enteric methane for the benefit of environmental, economic, and social sustainability for farmers and consumers.

Evaluation Tool

- Safety
- Efficacy
- Trade-offs and Benefits
- Adoption

Evaluation Tool – Safety

Animal and food safety are nonnegotiable. Feed additive safety is established on the basis of its composition and intended use. Safe handling is also important to supplement manufacturers, farmers and milk processors.

Safety	Points
1. Has FDA reviewed and approved the safety of the intended feeding directions for this feed additive? <ul style="list-style-type: none"> • Yes = 3 pts (<i>go to question 3</i>) • No = 0 pts (<i>go to question 2</i>) 	
2. Has the manufacturer reached a GRAS conclusion for the intended feeding directions for this feed additive? <ul style="list-style-type: none"> • Yes, a GRAS notification was submitted to FDA = 2 pts • Yes, independent GRAS status conclusion not submitted to FDA = 1 pt • No (<i>minimum requirement on safety not met</i>) = 0 pts 	
3. Does the feed additive label provide/include instructions for: <ul style="list-style-type: none"> • Safe handling = 1 pt • Storage conditions = 1 pt • Cautions and/or warnings for use = 1 pt 	
Total Points (0-6)	

Legend
5-6 points = High confidence in the safety for this use of the feed additive.
4 points = Moderate confidence in the safety for this use of the feed additive - (<i>consult your veterinarian</i>).
1-3 points = Limited confidence in the safety for this use of the feed additive - (<i>consult your veterinarian</i>).
0 points = Minimum requirement on safety not met.

Evaluation Tool – Mitigation Efficacy

Confidence on mitigation efficacy depends on the collective body of evidence. All study types play a role in establishing mitigation efficacy and the dose-response relationship.

Efficacy	Points	Legend
<p>1. Is there publicly available evidence supporting the stated enteric methane reduction amount of the intended feeding directions for this feed additive?</p> <p>Yes = 1 pt No (<i>minimum requirement on mitigation efficacy not met</i>) = 0 pts</p>		<p>5 points = High confidence in the estimate of enteric methane mitigation from this use of the feed additive.</p>
<p>2. What level of evidence is available for supporting the stated enteric methane reduction amount of the intended feeding directions for this feed additive? (<i>assign point credit for all that apply</i>)</p> <ul style="list-style-type: none"> • Meta-analysis = 1 pt • Randomized controlled trials (RCT) = 1 pt • In-vitro laboratory studies = 1 pt • Commercial field trials = 1 pt 		<p>3-4 points = Moderate confidence in the estimate of enteric methane mitigation from this use of the feed additive.</p>
Total Points (0-5)		<p>1-2 points = Limited confidence in the estimate of enteric methane mitigation from this use of the feed additive.</p>
		<p>0 points = Minimum requirement on mitigation efficacy not met</p>

Evaluation Tool – Trade-offs and Benefits

Positive return-on-investment (ROI) is an economic priority for dairy farms. Ideally, the use of a feed additive would not have undesirable impacts on milk production and composition, milk flavor and aroma attributes or reproductive health.

Trade-offs and Benefits	Points	Legend
<p>State the impact on the following when the additive is administered according to its feeding directions:</p> <p>Milk volume</p> <ul style="list-style-type: none"> • Not Tested = 0 pts / • Decrease = 0 pts / • Maintain= 1 pt / • Increase = 1 pt <p>Milk composition</p> <ul style="list-style-type: none"> • Not Tested = 0 pts / • Decrease = 0 pts / • Maintain= 1 pt / • Increase = 1 pt <p>Milk flavor and aroma</p> <ul style="list-style-type: none"> • Not Tested = 0 pts / • Off-flavor or Aroma = 0 pts / • No Change = 1 pt <p>Reproductive health</p> <ul style="list-style-type: none"> • Not Tested = 0 pts / • Decrease = 0 pts / • Maintain= 1 pt / • Increase = 1 pt 		<p>4 points = High confidence that this use of the feed additive provides benefits and/or acceptable trade-offs.</p> <p>2-3 points = Moderate confidence that this use of the feed additive provides benefits and/or acceptable trade-offs - <i>(consult your veterinarian and/or nutritionist).</i></p> <p>1 point = Limited confidence that this use of the feed additive provides benefits and/or acceptable trade-offs - <i>(consult your veterinarian and/or nutritionist).</i></p>
	Total Points (0-4)	<p>0 points = Unknown trade-offs and benefits</p>

Evaluation Tool – Results

1. Once you have answered the questions, tally up the total points from each section. The higher the score, the more criteria are met for potential usage.
2. Reference the legend in each section to determine if the feed additive meets your required standards for usage.

Safety	
Legend	
5-6 points = High confidence in the safety for this use of the feed additive.	
4 points = Moderate confidence in the safety for this use of the feed additive - <i>(consult your veterinarian)</i> .	
1-3 points = Limited confidence in the safety for this use of the feed additive - <i>(consult your veterinarian)</i> .	
0 points = Minimum requirement on safety not met.	
Total Points (0-6)	

Efficacy	
Legend	
5 points = High confidence in the estimate of enteric methane mitigation from this use of the feed additive.	
3-4 points = Moderate confidence in the estimate of enteric methane mitigation from this use of the feed additive.	
1-2 points = Limited confidence in the estimate of enteric methane mitigation from this use of the feed additive.	
0 points = Minimum requirement on mitigation efficacy not met	
Total Points (0-5)	

Trade-offs and Benefits	
Legend	
4 points = High confidence that this use of the feed additive provides benefits and/or acceptable trade-offs.	
2-3 points = Moderate confidence that this use of the feed additive provides benefits and/or acceptable trade-offs - <i>(consult your veterinarian and/or nutritionist)</i> .	
1 point = Limited confidence that this use of the feed additive provides benefits and/or acceptable trade-offs - <i>(consult your veterinarian and/or nutritionist)</i> .	
0 points = Unknown trade-offs and benefits	
Total Points (0-4)	

Best Practices & Research Gaps

Recommendations to Empower Informed Choices



Best Practices Currently Available



- GRAS notification to FDA is a recommended best practice to encourage transparency and manage risk. (Insight 2)
- Safe handling directions for feed additives should be provided and easily accessible to all intended users/handlers to maintain worker safety. (Insight 3)
- Feed additives should be re-evaluated for use as new scientific evidence becomes available in order to increase use confidence and update decisions accordingly. (Insight 6)

Best Practices Recommended for Development by Dairy Value Chain Stakeholders



- Develop and follow shared guidelines to qualify the evidence available for each feed additive mitigant. (Insights 4, 5, 11, and 12)
- Develop and follow recommendations for accurately measuring potential impacts of feed additive mitigants on economic performance. (Insights 7 and 12)
- Align on and develop a dynamic economic evaluation model/tool. (Insights 8, 11 and 12)
- Align on and create an environment for equitable environmental marketplace development. (Insights 9, 11 and 12)
- Identify and share the challenges/barriers for adoption across all value chain subsectors. (Insight 10)
- Genuinely engage on enteric methane mitigation across the value chain through collaborative industry forums like the Innovation Center for U.S. Dairy. (Insights 4, 5, 7, 8, 9, 10, and 12)



Contact

Juan M. Tricarico, PhD

Senior Vice President, Environmental Research
Dairy Management Inc.

juan.tricarico@dairy.org

