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Technology, nutrition and marketing

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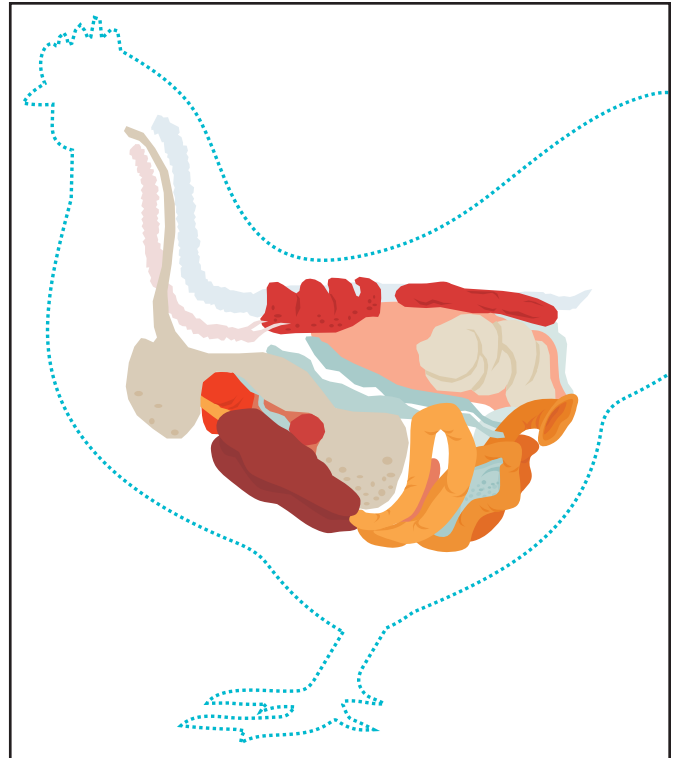
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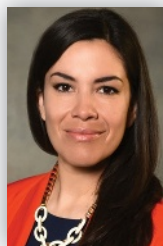
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# Trump hot topic among feed folks at IPPE

Though uncertainty at the onset of a new president's administration isn't unusual, the fast-paced, ever-shifting tone of President Donald Trump's first two weeks in office made him a hot topic at the 2017 International Production & Processing Expo (IPPE), recently held in Atlanta.

Vendors and attendees at the largest U.S. animal agriculture event seized every opportunity to discuss their feelings (positive and negative) at the onset of the new presidency. Many wonder how agriculture will fare under Trump. The American Feed Industry Association (AFIA), for one, has its concerns, but cites its eagerness to work with the new administration.

"The greatest challenge is understanding the new leadership's direction — how we can support that direction and offer additional information to play a role in policy changes," said Joel Newman, AFIA's president/CEO.

## Impact on regulations

Trump has also been especially vocal about rolling back regulations, signing his "one in, two out" executive order. Newman supports the food and feed safety efforts enacted under the Food Safety Modernization Act (FSMA), but sees this as an opportunity to revisit the more "onerous" aspects of the regulations and assist in making its implementation more sound and effective.

"Food-feed safety is one of our top priorities, but we recognize that FSMA is a whole new level of regulation both for the industry and FDA to implement," Newman explains. "We're focused on addressing the areas that will make that more practical for implementation and still accomplish the objectives of the administration."

## Trade outlook unknown

AFIA recently expressed its disapproval when Trump's campaign promise to withdraw from the Trans-Pacific Partnership became a reality. The TPP "was a good agreement for the feed industry. Those new exports would have created new jobs in the United States and helped the overall economy," Newman said, noting that, as the administration changes existing trade agreements and develops new ones, AFIA is at the table to ensure the animal feed industry is not losing the value of export trade.

Despite the decision to pull out of TPP, Newman is optimistic. "There will be challenges where we're going to need to do more work, but overall a new administration brings new opportunities for the feed and animal production industries," Newman said. ■

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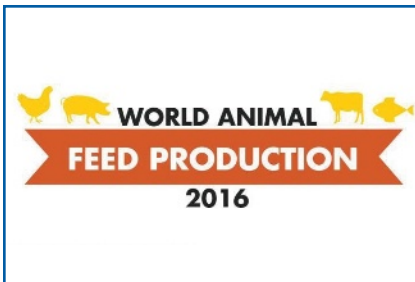


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# Gut health additives: four possible future scenarios

What does the future hold for the business of gut health additives over the next decade?

BY IOANNIS MAVROMICHALIS

“Antibiotics are dead. Long live gut health additives!” Indeed, this could very well summarize the prognosis by any health or nutrition professional when pressed for a quick answer on the future of gut health additives in the years to come. And, without giving it a second thought, they could be right, no? After all, antibiotics are being removed from an increasing number of feeds throughout the world, and we can all agree that at least these old compounds will not make a comeback — ever.

So gut health additives must continue taking their place, and what a great selection of additives we have. Even additives with no direct claims on antimicrobial activity try to benefit from this unexpected turn of events that saw long-established and inexpensive antibiotics being replaced by previously unheard of additives, at many times the cost and considerably less efficacy.

## The global additives business

In fact, the global additives business is growing at record speed, and it is estimated to exceed USD\$20 billion within a few years. Gut health additives certainly make an increasing proportion of this market as other products, such as amino acids and flavors, appear to have reached maturity. Looking at this bigger pic-



ture, it is no wonder that new additives are introduced each year, and old ones continue to enhance their claims, whereas new companies keep emerging trying to market new and old products to a shrinking clientele that is looking for immediate solutions now more than ever. After all, we still do not know how to replace antibiotics effectively, inexpensively and constantly; in other words, we have considerable room for improvement and growth.

If we were to consider the business of gut health additives for the next decade, we would have to ponder over all possibilities, even the most extreme. It is logical to assume that each scenario has its own proponents, especially when jobs and businesses are affected by the success or failure of all other possible scenarios. This remains a fluid market where all outcomes are possible. Here is what I believe could happen, in no particular order.

## 1 Nothing will change

Antibiotics will continue to be banned in even more countries, reaching a level where they will be considered virtually withdrawn from the global market. In contrast, the current trend to use the existing gut health additives will continue and even increase. New additives will find it harder to be registered and share a piece of this market. According to most professionals, this is the most likely scenario, at least for the foreseeable future. Based on this assumption, many new players are considering entering the market, and others expanding their portfolio, whereas only a few continue to investigate new additives.

The real danger in such an outcome comes from the consolidation in buyers and suppliers. A shrinking number of buyers (those who feed animals) will look to buy an increasing number of additives from a very small number of suppliers (manufacturers) — hence the “supermarket” effect in which all suppliers will sell all additives up to the point that these additives will become commodities with low margins and

standardized specifications. This will definitely benefit the buyers, but it will ensure the same fate to smaller additives suppliers as that enjoyed today by most pre-mix manufacturers: extinction.

## 2 A super additive will emerge

This is the dream of every researcher and additive supplier. It happened before, and it can certainly happen again. Lamentably, this will also probably mean this new additive will enjoy a narrow window of success before being copied, regulated or replaced by other products. Being first is important, and additive suppliers acknowledge this fact by spending vast sums of money on research. Some will ask what is left to discover, especially after the sprint of research activity in the past 20 years, and perhaps they are right. Others point to the undisputable fact that new additives, even the best ones, will have to face a battle uphill, not only against fierce competition from other additives, but also from an increasingly difficult regulation framework.



Read more online: Good poultry gut health needs a broad approach, [www.WATTAgNet.com/articles/24181](http://www.WATTAgNet.com/articles/24181)

Despite all these difficulties, and if I were to make a bold prediction here, I would say any new super additive would no longer be feed-borne; I believe it will be something administered through the water, the next frontier in nutrition and health management.

## 3 Microbes will produce their own additives

It is surprising how many drugs and additives are produced today by microorganisms, such as bacteria and yeasts. What if these same additives and drugs were to be produced in the gut by specifically designed microorganisms? Does the world of direct-fed microbials (probiotics) hold the key to our future?



## GUT HEALTH ADDITIVES

This is at least something to discuss with probiotic suppliers. In fact, there are already products that claim antimicrobial action against *Salmonella*. They are based on yeasts and bacteria. Here the keyword is antimicrobial peptides, also known as “bacterial or yeast biological warfare.” There is still much work to be done, but the beginning is interesting and very promising. Questions remain, and the most important one is whether these antimicrobial

**MOST EXPERTS BELIEVE BUSINESS will continue as usual, but I disagree.**

peptides are similar to the very same antibiotics being banned. If yes, then I foresee a quick death to this technology, as we will be coming back to the original problem of enhancing bacterial resistance to human antibiotics. I do not

believe this will be the case, but it is worth investigating before misinformation causes misregulation.

### 4 New drugs will emerge

If we were a pharmaceutical company sitting on millions of research dollars and employing the best minds available, we would definitely not want to sit idle watching our antibiotic business being overtaken by gut health additives, especially now that they are still not 100 percent effective in replacing our banned antibiotics, right? But what could we do? Should we use our ample resources to find new molecules, new drugs that could be used in animals without causing resistance to human-level antibiotics? And while we do that, would it not pay to launch a massive campaign to inform everyone about how harmless our new products will be and how in-

expensive and effective they will be when used properly?


A dream, you say? Indeed, it is a dream that cannot be easily transformed into reality, and this is why most antibiotic suppliers are buying into gut health additives, trying to maintain their clientele and recover part of their business — but they will fail as this is not their core expertise. For a core of few visionaries, this is not a dream but rather a challenge. Indeed, some are already working hard to find these “non-antibiotic” drugs. Some preliminary signs indicate that the dream will materialize, but there is still no estimated time of “arrival.” Could this be the long-term solution to gut health management?

### What to do in case of a disaster?

As mentioned, most experts believe business will continue as usual, but I disagree. I believe we will see a new upheaval in the gut health business, most likely caused by probiotics or new drugs. In this scenario, most current gut health additives will become obsolete, and the change will be a rapid one.

To guard against such an unpleasant scenario, some additive suppliers are looking into what benefits their products have beyond the boundaries of gut health. Others try to create a niche for their class of additives by tying them up with a feed formulation matrix variable — an almost impossible task. Others work hard to make their additives so effective or multitasking that they become indispensable. All of them, however, are aware of the impending danger, and in their minds there is a pressing question: how to make their additive(s) as successful as phytase — something the computer picks up automatically. But even the successful enzyme phytase faces an uncertain future; what if phosphates become cheap again? Impossible, you say? Perhaps, as impossible as antibiotics coming back? We shall soon see. ■

*This is the fourth article in WATT Global Media's 100-year anniversary series, which looks at key drivers that will shape the future of the worldwide poultry industry.*



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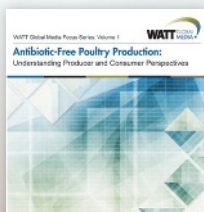
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### **Cage-free Eggs:** Consumer Trust in the Poultry Industry



# 4 feed formulation software

## trends shaping animal nutrition

Advances help animal feed manufacturers stay competitive

BY LAURA FERNANDEZ

Twenty years ago, feed formulation software was a luxury for feed manufacturers; now it is a necessity.

“Formulation is at the heart of the animal feed industry, at the junction between all the tasks of a feed manufacturer,” says A-Systems CEO Bruno Duranthon.

Today’s feed manufacturers are dealing with questions that didn’t even exist decades ago, like how to include enzymes in formulas for optimum performance, or what to do with large amounts of data. Thanks to software engineers,

advancements in feed formulation have turned these questions into new avenues for profit.

### Non-linear software addresses enzyme profiles

New advances in formulation software address the growing demand to include enzymes in feed. The changes take into account the non-linear pattern of enzymes in feed. Because enzymes do not behave in a linear pattern like other feed ingredients, it is difficult to use them with traditional formulation software and receive predictable results.



Non-linear software advises nutritionists about the way enzymes perform with other ingredients as well as the effects of enzymes at different inclusion rates. This helps the nutritionist to select the correct amount of enzymes for optimal animal performance. The software provides nutritionists with the correct enzymes to use in formulas as well as evaluates the effect and cost of using alternative ingredients.



How detailed NIR data benefits animal feed formulators:  
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### Data and analytics improve decision making

Over the past 15 years, the feed industry has collected a lot of data — more data than it has been able to use. Recent updates to formulation software are utilizing this data to help feed manufacturers make smarter decisions.

“Margins are getting smaller and smaller, so nutritionists and formulators need to make advancements that help them stay

## TODAY'S FEED FORMULATION SOFTWARE references formulas against relevant regulations and guidelines to ensure the feed is compliant.

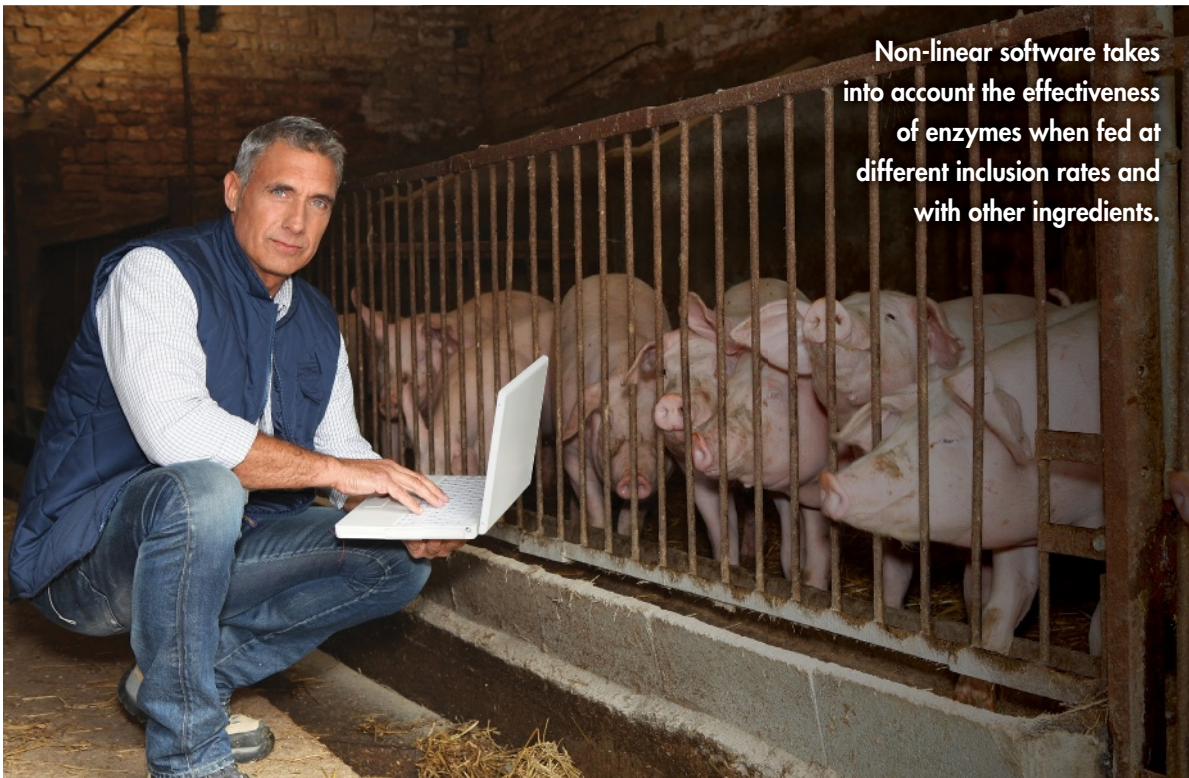
competitive,” says Adifo senior consultant Peter De Letter. “Feed manufacturers can now import and share data to help them make better decisions.”

For example, data can be

used to compare the costs of feed ingredients or to search for the best ingredients to improve animal performance.

The data is stored in one central database that can be easily

## FEED FORMULATION SOFTWARE



Non-linear software takes into account the effectiveness of enzymes when fed at different inclusion rates and with other ingredients.

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**“NOW IT IS NOT a matter of whether or not a company uses technology, it’s a matter of using the right technology.”**

**– Bruce Feist**

accessed when needed. This limits the number of times that data is put into a database, thus minimizing time and errors. And because it is easily accessible, users, whether they are nutritionists or product purchasers, are able to reference it on a daily basis to improve management and make smart business decisions.

### Regulation benchmarking keeps businesses in compliance

New releases of formulation modules are designed specifically to help feed manufacturers comply with complex regulations. New software compares the ingredients in feed formulas against current

regulations to make sure they are in compliance with relevant regulations. The modules also track what ingredients are in the formula, where they originate, and when they were added to the feed.

“We’re constantly investing in additional products that help our companies be compliant and have greater traceability along the supply chain,” says Format Solutions strategic marketing director Tarun Keswani.

In response to the 2017 Veterinary Feed Directive (VFD) changes in the U.S., Format Solutions released a new module that interfaces with GlobalVetLINK. The module generates and tracks reports as well as keeps records of prescriptions.

## Cloud technology enhances local, global collaboration

A growing demand by the industry is the ability to share information quickly and easily throughout a company and with customers. Cloud technology makes this possible.

“A lot of our customers want to have portals for better customer service,” says Adifo presales consultant Lynn Verstrepen. “This allows requested information, like a lab sample, to be handed in through a portal versus sending an email or manually writing the results.”

The software takes into account the large amount of consolidation in the feed industry over the past decades. Feed manufacturers can import and share data and analytics in different languages, and compare prices in a variety of currencies. This improves purchasing options for the feed mill, and provides the customer with the best service available.

## Formulation software crucial to moving forward

Today’s software is designed specifically to address the changing demands, requirements and trends. It is also designed to be easy to use and easy to implement. “To stay competitive in the feed industry, it is crucial to have an appropriate tool — and to have the proper technical support from an independent company,” Duranthon says.

When feed formulation software is used to its maximum, it is more than

just a powerful tool — it is a business solution. The ability for the feed industry to adapt to changes in technology and utilize tools, like formulation

software, is expected in today’s world.

“Perhaps 20 years ago a company could produce feed with minimal technology,” says Format Solutions



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## FEED FORMULATION SOFTWARE

**Recent advances in feed formulation use the large amounts of data available to select cost-effective feed ingredients to help livestock producers cope with tight profit margins.**

managing director Bruce Feist. “Now it is not a matter of whether or not a company uses technology, it’s a matter of using the right technology.” Feist says that a good way to describe where the feed industry is today is with the quote by journalist Graeme Wood: “Change has never happened this fast before, and it will never be this slow again.”



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Breakthroughs in formulation software have given it a prominent role in the feed industry. This role is expected to increase in the future with more advances in software and

a more tech-reliant industry. ■

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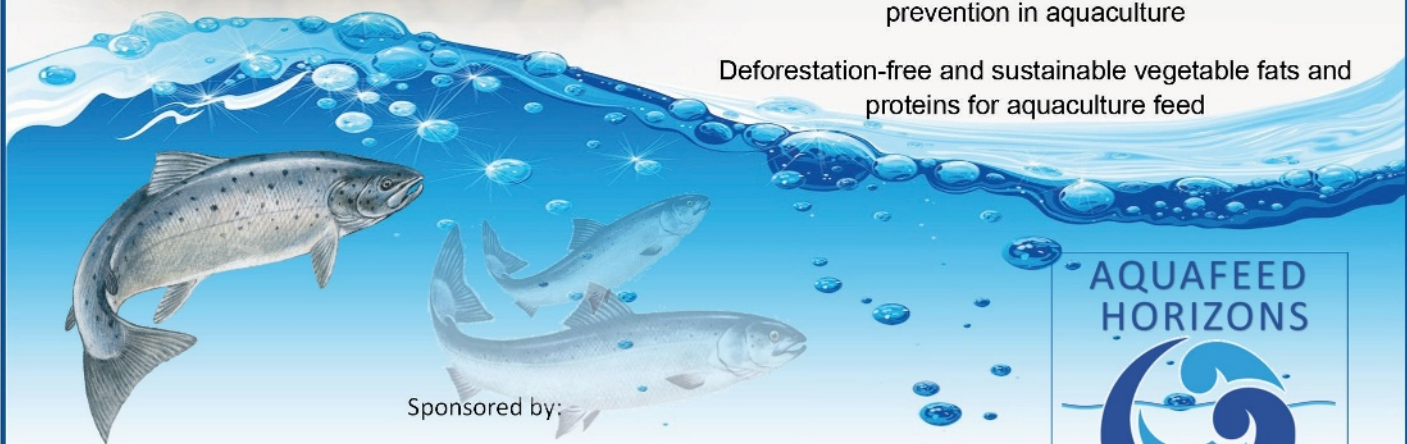
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# Feed phytogenic market growth shaped by global views

As interest in botanical animal nutrition solutions increases, BIOMIN survey reveals world livestock industry's outlook on the use of phytogenic feed additives

BY JACKIE ROEMBKE

New regulations and increasing consumer pressure have motivated animal protein producers, integrators, feed mills and premix companies to explore new ways to eliminate or reduce antibiotic growth promoters (AGPs). As a result, the interest in phytogenic feed additives (PFAs), or natural plant-based products shown to produce multiple positive physiological effects in livestock, has exponentially increased.

sales, and animal nutrition companies selling PFAs report 20 percent year-over-year growth. PFAs are applied to 5 percent of global livestock feed tonnage, but PFA suppliers are preparing to see this number surge.

Animal nutrition company BIOMIN predicts PFA sales will double every five to seven years moving forward.

“Looking at numerous scenarios based on feed production

duction including antibiotic-free and antibiotic-reduction strategies, and the growing demand for animal protein products, by 2030 we can expect the PFA market to total between \$1.7 billion and \$2 billion in annual turnover,” said Michael Noonan, BIOMIN’s global product manager of phytogenics.

As the market nears the brink of a major boom, a few speculative questions must be asked: Who uses PFAs? Are there regional disparities? Why wouldn’t a producer explore the use of PFAs? And what do livestock producers ultimately hope PFAs will achieve?

» The potential of phytogenic feed additives:  
[www.WATTAgNet.com/articles/22964](http://www.WATTAgNet.com/articles/22964)

To date, the size of the market has surpassed \$500 million in

trends, evolving consumer demands, changes in livestock pro-

## Survey respondent breakout

In late 2016, the 2017 BIOMIN Phytogenic Feed Additives Survey

set out to gauge the perceptions and experiences of stakeholder groups feeding, formulating and manufacturing livestock feed. Nearly 1,200 nutritionists, growers, veterinarians and consultants spanning multiple species in more than 100 countries offered their feedback.

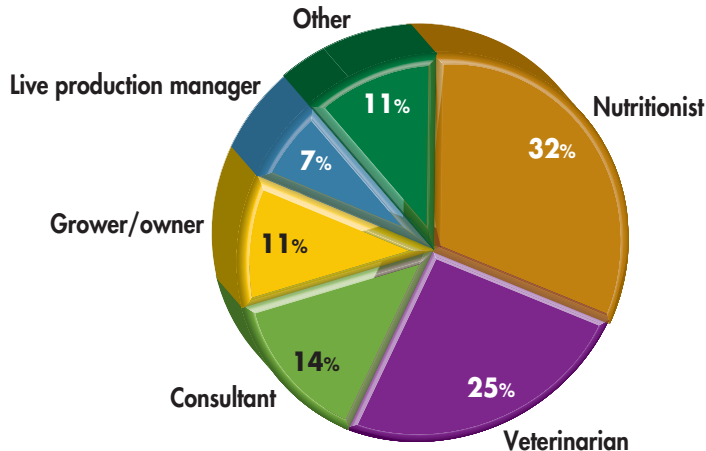
Fifty-one percent of survey respondents use PFAs in their animal feed formulations; 33 percent have never used PFAs; and 16 percent report having used PFAs in the past, but are not currently using them. Nutritionists accounted for one-third of respondents with past PFA experience, followed by veterinarians (27 percent) and consultants (20 percent).

### Perceived benefits of phyto-genic feed additives

Enhanced digestibility was the

## Breakout of PFA survey respondents

Source: 2017 BIOMIN Phyto-genic Feed Additives Survey



Nutritionists, vets and consultants accounted for more than 70 percent of completed questionnaires.

### Nutritionists, vets and consultants accounted for more than 70 percent of completed questionnaires.

primary benefit of phyto-genic feed additives. Perceived antimicrobial effects and the replacement of AGPs ranked in the No. 2 and No. 3 slots, respectively.

These results told a much more interesting story when dissected

by geography and job title:

- Though improved digestibility ranked highest (15 to 20 percent) with livestock producers and nutritionists, feed manufacturers were least likely to rank it as a crucial benefit.

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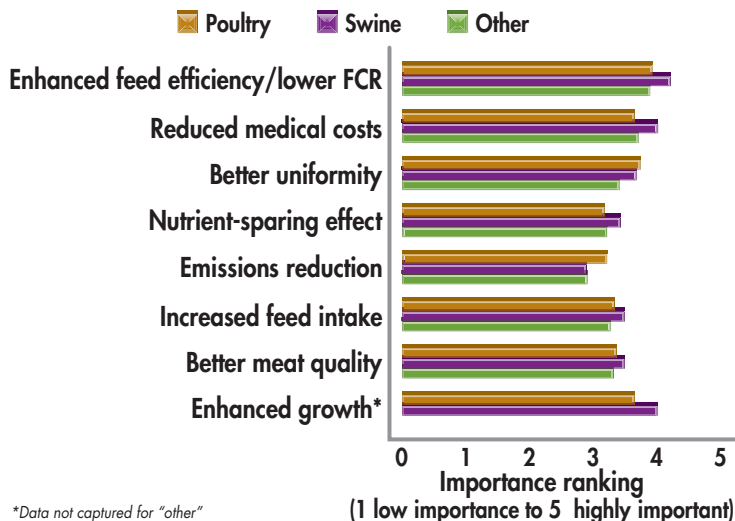
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## FEED PHYTOGENIC MARKET GROWTH

## Rank the importance of the benefits of PFAs

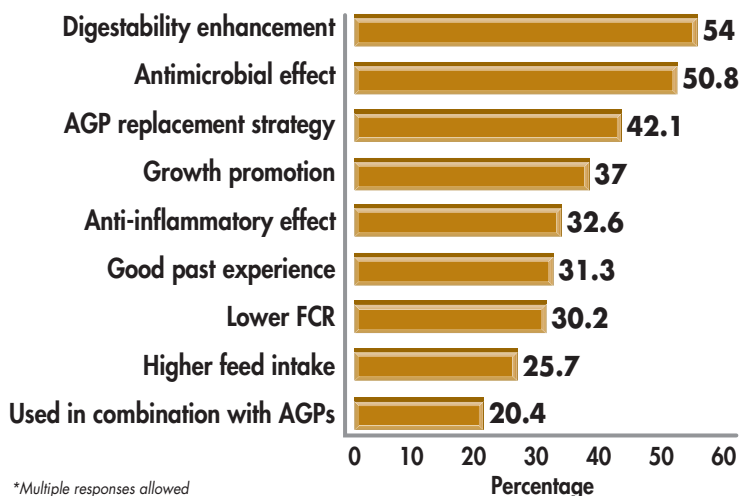
Source: 2017 BIOMIN Phytogetic Feed Additives Survey



Enhanced feed efficiency and lower FCR was identified as the most important PFA benefit to all groups of respondents. Emission reduction ranked the lowest.

## Top reasons for using PFAs\*

Source: 2017 BIOMIN Phytogetic Feed Additives Survey



Survey respondents identified enhanced digestibility as PFAs' primary benefit; however, antimicrobial effects and the AGP replacement ranked closely behind.

- In North and South America, antimicrobial effects were a key motivator for utilizing PFAs.
- Twenty percent of respondents use PFAs to replace AGPs.
- High feed intake was most important to piglet and broiler producers in Asia and Europe.
- Broiler and grower-finisher producers were the main group using PFAs for growth promotion.
- Feed manufacturers, breeders and egg/meat producers were most likely to use PFAs for anti-inflammatory effects; integrators and grower-finishers were the least likely.
- A lower feed conversion ratio was cited as a major reason to use PFAs in the Middle East and South America.

In Noonan's opinion, many factors contribute to the local differences surrounding the advantages of PFA use.

"Consumer awareness of antibiotics can vary from one country to another over time. In some markets it's been discussed for 20 years or more, while elsewhere it's a fairly recent topic," he said. "Likewise, relevant regulations – including AGP bans – have been adopted over several decades and appear to be gaining momentum. There is now a much more scientific focus on phytochemicals in Europe most likely tied to the 2006 AGP ban and ongoing search for natural alternatives to antibiotic growth promoters."

## Gauging industry views, applications

Respondents were also asked to rank the importance of PFA benefits on animal production. For poultry, swine and feed professionals, a lower feed conversion ratio and enhanced feed efficiency were identified as the most important benefits of PFAs. Reduced medical costs came in second for the swine and feed groups, while uniformity ranked highest among poultry producers.

The remaining of the PFA benefits (meat quality, growth enhancement, nutrient-sparing

effects) were perceived to have equal importance with the exception of emission reduction, which was the least important to swine and feed respondents.

Of the respondents using PFAs, 65 percent report using more than two different products; 30 percent use one; and 5 percent utilize more than five.

Taking a closer look by region, 70 percent of European, American and Canadian respondents integrate two to five PFA products into their animal feed formulations; 20 percent of American and Canadian respondents incorporate more than five phytogetic products into their feeding programs. In contrast, Asian participants tend to stick with one product.

### Objections to PFA use

According to survey respondents, the top two reasons for not using phytogetic feed additives is the uncertainty of which product to choose and a perceived lack of sufficient commercial trial data.

## THE PHYTOGENIC FEED ADDITIVE market is poised to reach \$2 billion in sales by 2030.

More so than in any other region, European PFA adoption was hindered by their inability to choose between the PFA products on the market. The difficulty of product selection was the most frequent choice among growers, owners and live production managers.

Fourteen percent of respondents do not utilize PFAs because they feel there is a lack of scientific research; these respondents tended to be from Asia, Europe, United States and Canada. The lack of commercial trial results was a prevalent objection among Asian, African and Middle Eastern respondents.

“Our understanding of phytoGENICS has progressed a great deal over the past three decades,” Noonan said, citing the company’s more than 300 commercial trials and

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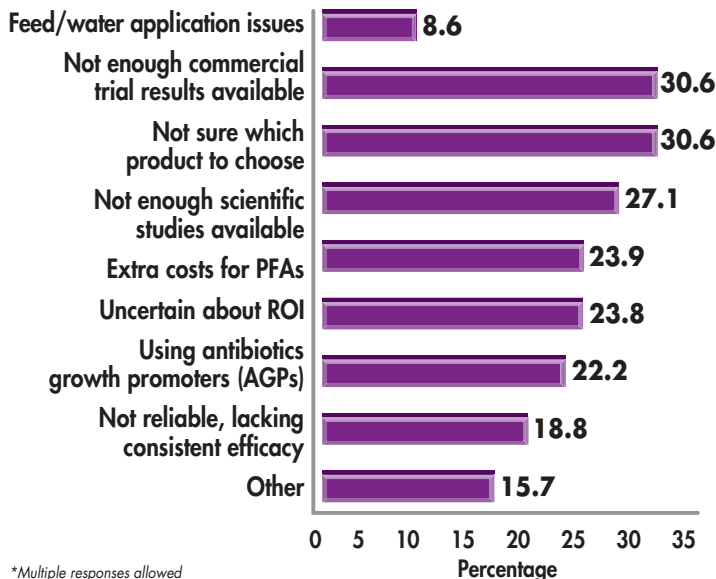
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FEED PHYTOGENIC MARKET GROWTH

**Top reasons PFAs are not utilized\***

Source: 2017 BIOMIN Phytogetic Feed Additives Survey



**Fifteen percent of respondents report that a lack of commercial trial data or uncertainty regarding which product to choose prevent them from integrating PFAs into their livestock feed.**

U.S. and Canada respondents cited questions about the return on investment of PFAs as their primary objection.

Noonan feels these customers should be open minded to the effectiveness of phytoGENICS and the value they can add to a business.

Meanwhile, respondents who have chosen to stick with AGPs rather than explore the benefits of PFAs were located in Asia and South America.

“Communication and education are the backbone of our effort to engage the

industry,” Noonan said. “We see this PFA survey as an effective tool to gauge the clients’ perceptions and address their specific situations. We will repeat the exercise in order to track changes in market sentiment and continue the dialogue going forward.” ■

20 co-authored scientific papers in 2016. “The vast array of different plant-based compounds and substances means that there is plenty left to discover. I would highlight the experience of early adopters -- livestock producers who have used PFAs successfully for many years.”

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# US grains benefit from strong **Mexican trade relations**

American grain industry fears for future of export trade with its largest corn importer

BY BENJAMÍN RUIZ

In 2016, the United States experienced a record harvest of 387 million metric tons of corn. This trend is expected to continue due to ethanol production, an increased domestic demand for feed, and grain exports. However, given the political climate under the Trump administration, many are concerned about the future of trade.

Mexico is the No. 1 importer of U.S. yellow corn worldwide, surpassing Japan for the past two years, the U.S. Grain Council (USGC) reports. Mexico also ranks No. 2 in U.S. DDGS imports and brings in large volumes of U.S. barley and sorghum.

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importer  
of US corn  
in 2015 and  
2016.**



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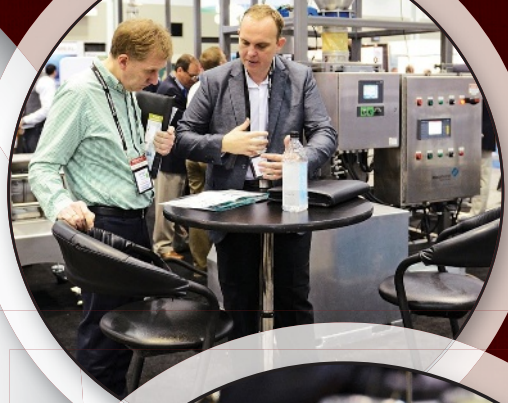
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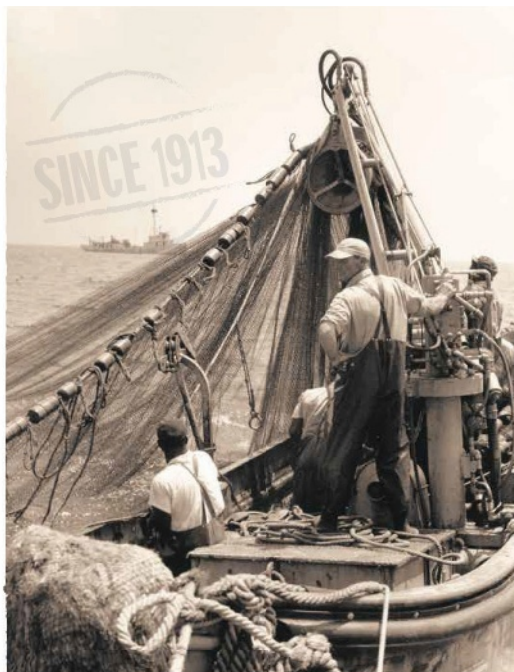
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MEXICAN TRADE RELATIONS



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According to the U.S. Department of Agriculture (USDA), Mexican corn consumption is forecast to increase 1.6 percent during the 2016-17 marketing year. “This increase is expected to be driven mainly by the expansion in the Mexican livestock and poultry sectors,” cites the GAIN Report.



Benjamin Ruiz

**Ryan LeGrand, USGC director in Mexico, says the grain trade between Mexico and the United States is vital for both countries.**

Historically, Mexico has imported 10 million to 11 million metric tons of corn from the United States; however, in recent years, the country has imported record volumes — 13 million metric tons in 2015 and 14 million in 2016. This bump can be attributed to North American Free Trade Agreement (NAFTA), which quadrupled U.S. corn exports since its inception.

Ryan LeGrand, director of the USGC in Mexico, believes U.S. President Donald Trump will eventually realize the economic value of the U.S. agricultural sector and its exports.

“The relationship of bilateral trade between Mexico and the United States is so important for both countries that you cannot cancel” NAFTA, LeGrand says. “Both economies depend on each other.”

In 2016, U.S. corn exports to Mexico totaled more than \$17 billion.

### More domestic production

In 2016, Mexico produced more corn than ever, hitting 15.4 million metric tons. Mexican domestic consumption is impressive. In addition to the poultry industry, “other livestock sectors are growing. Last year, Mexico exported more beef than ever, and pork exports to China, the

## Corn: quality, production better than ever

In 2016, U.S. corn production was 386.8 million metric tons, an increase of 7.11 percent compared with the 2014 record crop year. The U.S. is the largest corn exporter, with 39.2 percent of world exports in the 2016-17 marketing year. *Source: USGC*

largest market in the world, are starting,” LeGrand says. All this translates to increased grains demand.

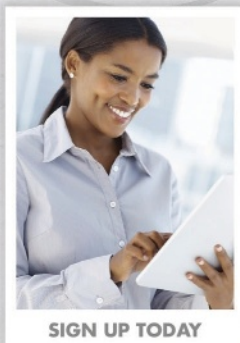
Meanwhile, despite the disparities between the Mexican peso and the U.S. dollar, imports are increasing “and paying in dollars when the exchange rate goes through the

roof.” (About 22 pesos per dollar when this article was written.)

“It’s been difficult,” adds LeGrand. “What has helped is that U.S. grain prices are very cheap. Imagine if we had current prices and an exchange rate of 15. We would import more.”

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## MEXICAN TRADE RELATIONS

## MEXICO IS ALSO A major consumer of US sorghum.

As for white corn, what is not used for human consumption is sold to the animal agriculture market.

### Lagging sorghum imports

Though it grows 4 million metric tons of sorghum domestically, Mexico is also a major consumer of U.S. sorghum. However, in recent years, the situation changed when China entered the global market

due to soaring corn prices. The Chinese are willing to pay more for sorghum than Mexico, so that has affected Mexican imports, LeGrand explains.

“But, for every metric ton of sorghum that Mexico does not im-

port, it imports one metric ton of corn, and that’s why we’ve seen a sharp increase in imports of yellow corn for animal feed,” LeGrand explains. In 2016, U.S. farmers grew 12 million metric tons of sorghum. ■

## Quality sorghum, but lower production

U.S. sorghum production in 2016 was 11.7 million metric tons, a 23 percent decrease compared with the 2015 crop year. The U.S. is the largest sorghum exporter, with approximately 73.6 percent of world exports in the 2016-17 marketing year. *Source: USGC*

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# 5 advanced feed formulation secrets about minerals

It takes years of trial and error to be able to fully comprehend why some feed formulas are possible and others will not work.

BY IOANNIS MAVROMICHALIS

Feed formulation remains 10 percent science and 90 percent experience, not because there is no sufficient scientific background to support this exercise of balance, but rather because it remains a job learned after college. Not many universities teach feed formulation, not even at post-graduate years, and even less — if any — go into any serious depth on the matter.

Some graduates with animal nutrition courses in their curriculum have been in a class where an oral presentation was made on how feed is formulated. A few

fortunate ones had the experience of formulating a real diet using a feed formulation program on a computer. Even then, it takes years of trial and error to be able to fully comprehend

why some formulas are possible, whereas others will not work in the field. The following “secrets” are topics often neglected and come from my own experiences.

## 1. There is more iron than is seen on paper

Most formulas for monogastric animals are fortified with up to 100 ppm iron, usually from iron salts like iron sulphate. This usually is more than sufficient to cover the animal’s needs, ignoring iron contributions from natural ingredients, such as corn, wheat and soya. This is normal practice followed for all trace minerals like iron. In the case of iron, however, there is often a further iron source, that of dicalcium or monocalcium phosphate. These calcium and phosphorus (mainly) sources can contain up to 8,000 ppm iron, whereas more viable sources of phosphorus, such as phosphate rock, contain up to 19,000 ppm iron (NRC, 2012). Adding 10 kg/MT of dicalcium phosphate (8,000 ppm iron) will provide the finished complete diet with an extra 80 ppm of iron. This would have been 190 ppm extra if rock phosphate was used instead.

In addition, some feeds for young animals are fortified with a yellow dye, which is usually iron oxide, at 1 kg/MT — a usual dosage. This equals to another 700 ppms (iron oxide contains roughly 70 percent or 70,000 ppm iron). Here the problem is not so much on animal toxicity or environmental pollution but on the fact that *Escherichia*

Most minerals used in animal feeds are natural mined ores, and they can contain contaminants that create variability in their concentration and availability of useful nutrients.



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## SECRETS ABOUT MINERALS

*coli*, a pathogenic bacteria species endemic in the hindgut, thrives on excess iron (and protein). Controlling total iron concentration in sensitive feeds requires more than actually checking levels against the trace mineral premix label.

## 2. Limestone is not just calcium carbonate

This is a common misconception I was ascribing to right after graduate college. It took my boss to tell me that pure (chemical) calcium carbonate is not the same as limestone. Pure calcium carbonate contains 38 percent calcium, but limestone can contain from 22 up to 38 percent calcium (in its most pure form). The difference in calcium concentration is natural contaminants from the process of mining limestone from earth mines. Depending on the source, location and process, calcium concentration can be quite different from what is anticipated.

Again, this would not be a problem for most animals, but we have layer hens, dairy cows and young piglets that

require more precision regarding their calcium intake. Too much and they have problems, not enough and they do not perform well. This is why many have abandoned limestone or use it only in non-sensitive feed formulas, preferring the more standardized form of chemical, feed-grade calcium carbonate.



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## 3. There is calcium everywhere

Calcium carbonate, even in its chemical form, is a very inexpensive material, and it is quite often used as a carrier for several additives and most premixes and concentrates containing a high proportion of minerals. In addition, it is often added, most usually in the form of limestone, as

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## SECRETS ABOUT MINERALS

a flowing agent in soybean meal and other such “oily” protein sources of vegetable origin. The inclusion rate is about 0.5 percent, which is equivalent to 1 kg of extra limestone per metric ton complete feed with an average inclusion rate of 20 percent for soybean meal. Perhaps the use of calcium carbonate as a carrier and flow agent often explains why feed sample analyses always show calcium to be much higher than feed specifications. A slight excess of calcium is not necessarily detrimental, but certain classes of livestock and poultry suffer from excess calcium in their feed.

#### 4. Can inorganic minerals be as bioavailable as organic ones?

Indeed, certain central authorities have concluded, based on many experiments, that not all organic forms are better in terms of bioavailability when compared with inorganic forms. In other words, the established norm that

organics are always more bioavailable than inorganic trace minerals is erroneous. There are inorganic forms that are as available or even more so than certain organic trace minerals. At the end of the day, it is the individual product that needs to be examined, and even then, not only in its pure chemical form, but also in terms of contaminants. For example, the presence of  $MnO_2$  contaminant in manganese oxide ore diminishes the bioavailability of manganese, even though the amount of total manganese appears similar or higher.

#### 5. A word about phytase

Not all phytase products on the market are the same. They all differ in technical aspects and, above all, in bioefficacy. But once a specific product is selected, the manufacturer’s recommendations should be used as far as phosphorus release levels are concerned. In general, a single dosage of phytase will release 0.08 to 0.10



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percent phosphorus as bioavailable (poultry) or digestible (pigs). New generation phytases can release more, and the same is true if additional normal phytase is added.

It is interesting to note that many manufacturers ensure they exceed the declared efficacy per dosage to guard against potential losses, but this is another story. In times of phosphate high prices, a second dosage of phytase can be calculated as 50 percent as efficacious as the first one — in lieu of more concrete data from the specific manufacturer. In other words, the second dosage of phytase will release an additional 0.04 to 0.05 percent bioavailable or digestible phosphorus. ■

**THE USE OF CALCIUM carbonate as a carrier and flow agent often explains why feed sample analyses always show calcium to be much higher than feed specifications.**



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# Fiber-degrading enzymes increase dairy cow milk production

Literature review examines experiments where dairy cows benefited from various enzyme combinations, doses

BY FERNANDO DIAZ

The lactational response of dairy cows fed fiber-degrading enzymes has been scarce and inconsistent. The effectiveness of fiber-degrading enzymes to improve milk production has only been observed in 30 percent of studies; however, eight experiments showed positive results.

Based on the experiments included in this literature review, the average increase in milk yield due to the enzyme addition was 5.5 lbs./day (2.6 to 13.9 lbs./day); none of these experiments reported reduction in milk yield when the cows were fed fiber-degrading enzymes. The response, however, was highly dependent on enzyme dosage, enzyme combination and the method of enzyme application to the diets.

## Low dosages yield positive results

University of Delaware researchers studied the effect of a carboxymethyl cellulase (CMC) and xylanase complex at two different concentrations on milk production in lactating cows.

Surprisingly, the authors reported that enzyme treatment at low, 1,600 CMC and 7,300 xylanase units per pound of forage dry matter (DM), but not high,

4,000 CMC units and 18,200 xylanase units, concentrations improved milk production by 6.8 percent.

Similarly, supplementing a fiber-degrading enzyme mixture enhanced milk production by 3.2 percent at a low dosage rate (1.2 g/lbs of DM) in early lactating cows, but not at a higher concentration (2.3 g/pound of DM) in another study.

## Enzyme activity impacts outcome

The University of Delaware results contrast with those of another experiment conducted at the University of Idaho.

Milk production was enhanced by 13.9 lbs/day in early lactation. Cows receiving an enzyme solution containing cellulases and xylanases increased production at a rate of 1.1 ml/pound of forage DM. Milk yield, however, did not increase in cows fed lower and higher amounts of enzymes (0.6 and 2.3 ml/pound of forage DM, respectively).

The lack of response at low concentrations indicates insufficient dietary enzyme activity; however, the explanation for reduced enzyme response when added at higher rates of supplementation is less evident.

Three possible hypotheses have been proposed for the lack of response when enzymes were used at high doses:

- It may be partially attributed to negative enzyme feedback inhibition by the increased concentration of a product of the enzyme-substrate interaction.
- Fermentation of sugars produced by cell wall hydrolysis may reduce ruminal pH to levels that inhibit cell wall digestion.
- It is possible that exogenous enzymes compete with the rumen population for cellulose binding sites available on feeds.

The fact that it is possible to either overfeed or underfeed enzymes makes their application complex and emphasizes the need to determine optimal concentrations of enzyme additions necessary for any given feeding situation.

## Role of enzyme combinations

The source and combination of specific enzymes are also important factors in improving lactation response.

University of Delaware researchers compared the effects on milk production of two different cellulase-enzyme complexes derived from different fermentations of the same organism combined with a single xylanase-enzyme complex.

Milk production was similar for cows fed untreated forage or forage treated with the enzyme complex EA2 (3,700 carboxymethyl cellulase and 14,000 xylanase units); however, production increased by 5.5 lbs. in cows fed EB1.2 (3,600 carboxymethyl cellulase and 11,000 xylanase units).

## Portion plays a part

Two studies conducted by a Canadian research group showed that the lactation response of dairy cows fed fiber-degrading enzymes depended on the portion of the diet to which the enzyme complexes were applied.

In the first study, the researchers reported an 8 percent increase in milk production in cows fed alfalfa hay cubes treated with 1 g/lbs of an enzyme supplement compared with untreated cubes. There was no response, however, in milk yield when concentrate and cubes were treated with 0.5 g per pound of the same enzyme complex.

In a subsequent experiment, milk yield was 4.6 lbs/day higher in cows fed a commercial enzyme product added to the concentrate than cows fed a control diet. However, applying the same enzyme complex to the total mixed ration (TMR) did not affect milk production.

It has been suggested that enzymes applied to a TMR immediately prior to feeding may be released into the rumen fluid and pass rapidly to the lower tract before they can be effective in the rumen. Increased postruminal digestion due to enzyme supplementation of the TMR may improve apparent digestibility in the total tract without increasing milk production.

## Effects on milk components

Milk fat of cows fed enzymes increased in only three out of 19 experiments included in this literature review.

In one experiment, fat yield increased as a result of higher milk production. In another experiment, it was due to an increase in milk fat concentration. In a third study, however, higher milk fat yields in cows fed enzyme-treated diets were not accompanied by significant increases in either milk yield or milk fat concentration.

Significant increases in milk protein yield due to the addition of fiber-degrading enzyme to dairy diets were observed in four out of the 20 experiments that reported milk protein yield.

# DAIRY COW MILK YIELDS and milk components benefit from enzyme combinations.

» Read the first installment in this three-part series on exogenous enzymes, Benefits of fiber-degrading enzymes in dairy cow diets: [www.WATTAgNet.com/articles/29130](http://www.WATTAgNet.com/articles/29130)

In two other studies, milk protein content improved with the inclusion on fibrolytic enzymes; however, milk protein yield was unaffected.

Editor's note: This is the second installment in a three-part series on exogenous enzymes. ■

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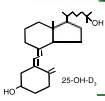
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