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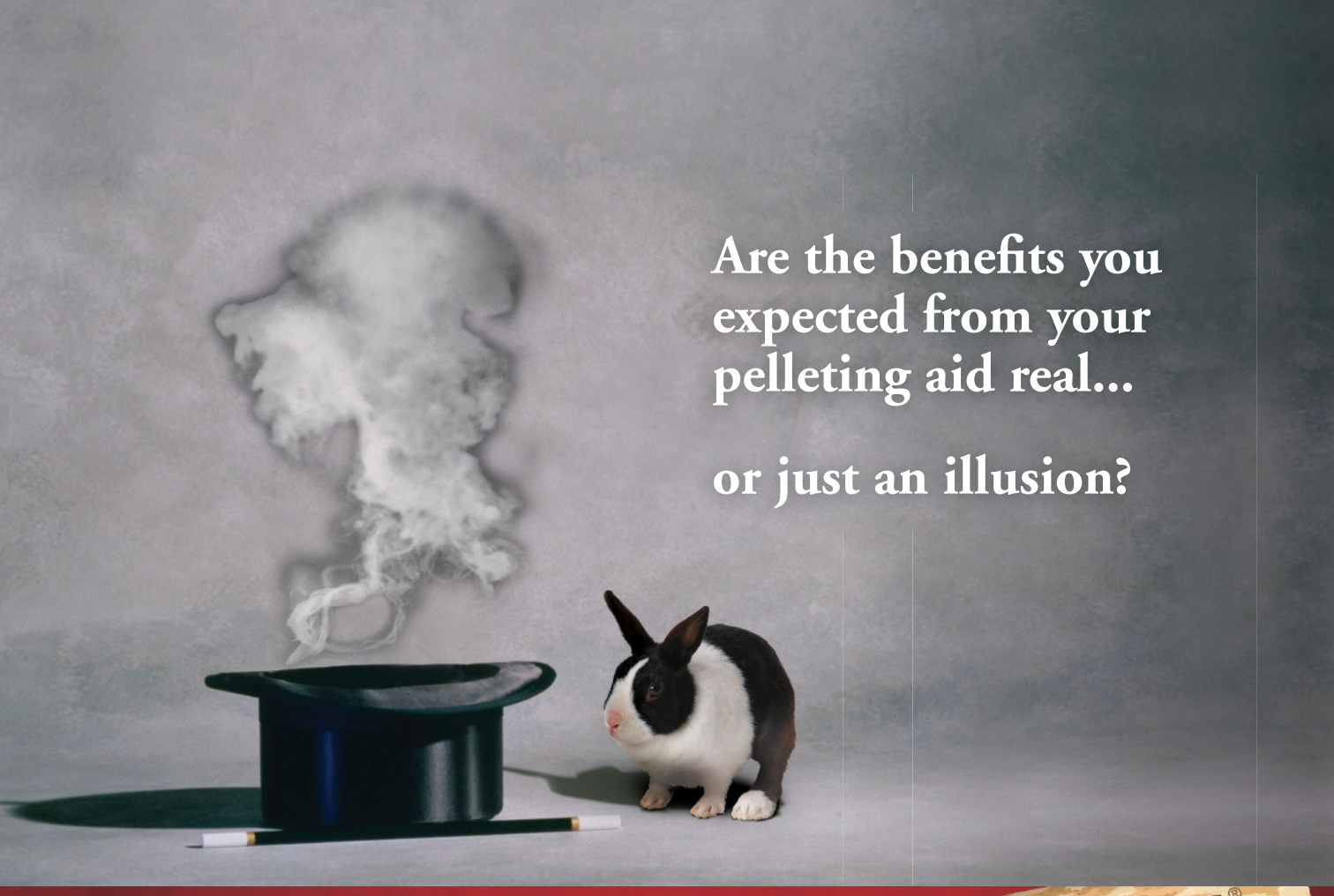

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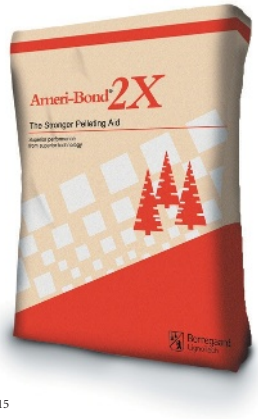

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Features

FM IN THE MIX

BY JACKIE ROEMBKE, EDITOR

Today's seed innovations drive the feed supply of the future

As WATT Global Media celebrates its 100th anniversary, a look at where the production of feedstuffs has been and where it's going

WATT Global Media

WATT Global Media's first publication, the September 1917 issue of the Poultry Tribune

This issue's cover story strays slightly from our usual Feed Management topics. The feature, "Seed biotechnology: The impact on animal production," is the second installment in WATT Global Media's 100th anniversary series, a 12-part series examining the drivers shaping the animal agriculture industry of the future.

Since the first WATT magazine, The Poultry Tribune, was published in 1917, crop production has been wildly shaped by advancements in agronomy and biotechnology. In 100 years, agribusiness has achieved many impressive feats. For example, corn yields averaged less than 30 bushels per acre; in contrast, 2016 U.S. corn production reached a record 175 bushels per acre, the USDA reports.

The need to improve crop production was a challenge back then, and it remains one today. To feed the world's population of 9 million in 2050, total food production will need to increase by 70 percent, the UN's Food & Agriculture Organization (FAO) reports. However, yield growth in developed countries has slowed, arable land is limited and climate changes will increasingly threaten production.

While food security innovations, such as vertical farming, are in their infancy, many are banking on developments in seed biotechnology to meet the cereal demands of the future. Unfortunately, the seed industry must overcome "decades of neglect in the agricultural research and development effort."

Given the promise of deregulation under the Trump administration, perhaps some of seed technology "with no hope of ever seeing daylight" will be taken off the shelves and re-examined to this end. Time will tell, but hopefully it doesn't take 100 years to get there. ■

FeedManagement

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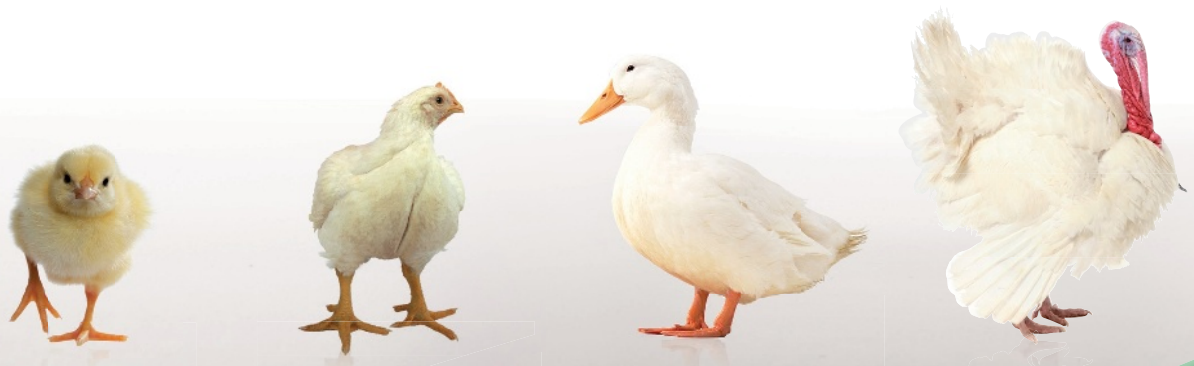

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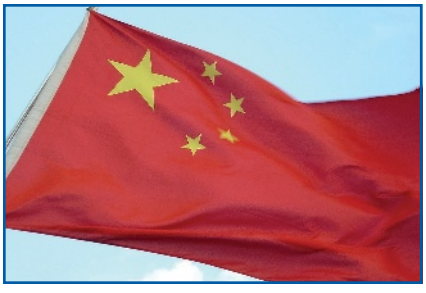

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This is the first article in WATT Global Media's 100-year anniversary series.

Seed biotechnology: The impact on animal production

Agribusiness looks to biotechnology to improve crop protection, traits to feed the world of 2050

BY JACKIE ROEMBKE

Over the course of two decades, genetically modified (GM) crops have offered many benefits to farmers, consumers and the environment, including the use of fewer pesticides, larger yields and lower food and animal feed costs.

According to Robert Fraley, Monsanto executive vice president and chief technology officer, GM technology has increased crop yields by "an average of 21 percent worldwide and reduced the use of pesticides by 37 percent."

ADVANCES IN SEED BIOTECHNOLOGY will enhance crop traits to lower feed costs and improve animal health in the future, but political and social obstacles may hinder such progress.

Today, 28 countries legally grow GM crops, most commonly corn, soybeans and cotton. For example, in the United States, GM seeds account for 93 percent of corn and 94 percent of soybean production.

While many countries ban or prohibit the cultivation of GM crops due to regulations, trade concerns and public perception, they allow for the import of GM products, i.e. raw materials, animal feed and processed human foods.

Only seven countries have completely banned GM cultivation and imports.

Politics aside, the world is facing very real challenges that may prompt further exploration into the potential of seed biotechnology. By 2050, food production will have to increase by 70 percent to feed a global population of 9.7 billion. To do so will require intensification in crop and animal protein production.

For those working in animal agriculture and its allied industries, the availability, quality and price of feedstuffs is an evergreen concern. Looking to the future, the following innovations will play a large part in securing a sustainable and abundant cereal supply. However, in the short term, GM seed technology must overcome a series of significant obstacles.

Key areas of seed biotech research

Seed biotechnology introduces genetic variations outside of the crop species' natural traits, allowing the farmer to be more efficient and profitable while leaving a smaller environmental footprint. For animal food producers, the selection of certain traits can reap considerable benefits for their bottom line.

Conducted in the public and private sectors, here are four areas of seed biotechnology innovation that will directly affect the producer's margins and improve animal health:

1. SUPPLY: Higher yields

The UN's Food and Agriculture Organization (FAO) reports 90 percent of the growth in crop production will come from "higher yields and increased cropping intensity." Eighty percent of that growth will come out of developing countries.

We "will have to have more intensification," says Dr. Tom Clemente, professor with the University of Nebraska-Lincoln's Department of Agronomy and Horticulture. "We need more corn or soybean crops that can grow in higher density because we have less arable farm land."

@ Future of biotechnology, feed exports hinges on EU-US trade talks
www.WATTAgNet.com/articles/22104

Genome editing holds a lot of promise in increasing yield potential beyond crop protection.

2. PROXIMITY: Climate adaptability

Research is being conducted in hopes of producing drought- and frost-resistant varieties of row crops as climate change will impact what's being planted and where.

"That's going to be the real influence of climate change — can the plant handle extreme conditions at critical times?" Clemente says.

The European Commission's DROP program is exploring "genetic patterns linked to water efficiency and drought resistance" in corn, wheat and sorghum.

3. SAFETY: Mycotoxin resistance

With weather extremes comes the increased threat of mycotoxins.

According to the U.S. Food & Drug Administration (FDA), mycotoxin contamination causes $1.64 billion in revenue losses annually, but that figure will likely be driven higher with climate shifts.

Researchers are developing fungus-resistant seeds to assist in preserving pre- and post-harvest grain quality.

4. NUTRITION: Nutrient manipulation

According to the International Service for the Acquisition of Agri-Biotech Applications (ISAAA), the nutritional enhancement of GM crops "targets manipulation of levels of proteins and amino acids, fats and oils, vitamins and minerals, carbohydrates and fiber quality, as well as decreasing the levels of undesirable components in major feed crops."

GM corn, for example, is being developed to include higher levels of methionine and strides are also being made in eliminating anti-nutrients from other feed grains.

Will mega mergers stall innovation?

Over the past year, six of the seven largest seed producers announced merger and acquisition (M&A) plans: ChemChina's $43 billion bid to takeover Swiss seed and pesticide group Syngenta; German drug and crop chemical maker Bayer's aim to acquire U.S. seed company Monsanto for $66 billion; and U.S.-based Dow Chemical's $130 billion merger with DuPont.

"It benefits seed companies to be low-cost producers," explains Elizabeth Hund, senior vice president and division manager of US Bank's food industries division. "During a broad downturn in commodity prices, M&As will allow the big seed companies to survive. They'll be

Ongoing seed biotechnology research strives to increase yields and mitigate on-farm challenges for feed crops, like soybeans and corn.

endomotion, Bigstock.com

Advances in genome editing

The future of seed technology lies in genome editing. Seed powerhouse Monsanto, for example, believes "gene editing has the potential to speed up value for growers for any trait for which a crop has variation" and may improve several crops in its research portfolio. "This is a very fast-moving field with many opportunities for 'how' one edits, but value for growers and consumers is created by 'what' one edits," Monsanto said in a statement prepared for this article. The CRISPR (clustered regularly interspaced short palindromic repeats) method is on the forefront of genome editing innovation. It is cheap, fast and versatile gene editing, allowing scientists to cut existing genes or add new ones. In addition to producing drought- and disease-resistant crops and also increase yields, CRISPR technology has generated added excitement because it does not fall under the GM regulatory guidelines in the United States, "though its regulatory status remains uncertain in importing countries," Parrott explains. The genome editing technology is, however, in its infancy. Monsanto admits it's in the "early days of exploring the potential applications of this promising science." Some sources suggest CRISPR-derived seeds may become widely available within the next five to 10 years.

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able to reduce costs and become more efficient, which better positions them to deliver margin on their stock."

Critics argue that the elimination of competition violates anti-trust regulations, threatens food security and may suppress innovation. Hund believes mergers can spark the research and development of new products.

"These companies will continue to try and extract value, and that's going to be through innovation and differentiation — all the technology that they can cultivate," Hund says.

PUBLIC PERCEPTION AND EXCESSIVE regulation pose the greatest obstacles to the development of the necessary advances in biotechnology.

In addition, she suspects secondary opportunities may present themselves as new divisions spin off the merged portfolios and the companies explore new sources of revenue generation.

Respective regulatory bodies plan to approve or deny the legitimacy of these transactions in early 2017.

Threats to progress

There are a series of legal, social and economic challenges repressing new seed technologies. Public perception and excessive regulation pose the greatest obstacles to the development of the necessary advances in biotechnology.

The cost of regulation has become "an almost insurmountable challenge" for the development of many new biotech products, says Dr. Wayne Parrott, professor of plant breeding and genomics with the University of Georgia.

"The cost is inversely proportional to the risk involved," he says. "Spending $30 million on safety tests gives the same level of safety that $2 million to $3 million does."

"Regulation is absolutely stifling innovation," Parrott notes. "Theoretically, if a country does safety testing by the CODEX Standard, that testing should be accepted around the world, which is the case for every single food except for GMOs where you see many countries wanting to run their own tests."

Meanwhile, the consumer's perception of GM foods has been tarnished by activists and misinformation, culminating in the United States' push for GM labeling laws.

"You know, I have been in this business my whole career and I have never been pessimistic until this past year," Parrott says. "The point of no return, I think, is the labeling law. We avoided the labeling issue — the 50-different-labels issue at a national level — but not at the international level."

Feed, animal protein industries key to biotech's success

Despite long-term challenges, food industries likely will prevail in shifting the public dialogue out of sheer necessity. In the short term, however, it's animal feed and food producers who will make the case for safe and cost-effective GM grains and the progression of seed research.

"The amount of [new GM seed varieties] with no hope of seeing daylight is just astonishing. It has nothing to do with the safety of the products; it has everything to do with overregulation," says Parrott. "It's the feed sector where this technology has the best chance of succeeding and moving forward." ■

References available upon request.

This is the second 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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How Ridley feed mills benefit from lean principles

Ridley's director of lean Chris Petersen discusses how the adoption of lean manufacturing principles improve customer satisfaction, workflow in feed manufacturing

BY JACKIE ROEMBKE

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The application of lean principles to U.S. manufacturing operations took hold in the 1990s when James Womack, Daniel Jones and a group of Massachusetts Institute of Technology (MIT) researchers introduced the concept of lean, or the elimination of waste from a manufacturing process, as shorthand for Toyota's production model. Since, countless businesses in various industries have adopted the continuous improvement mindset implemented using lean methodology.

"There are universal truths that apply in almost any industry," explains Chet Marchwinski, communications director of the Lean Enterprise Institute Inc. (LEI). "No matter what business you're in, you need to get the right product to the right customer at the right cost if you're going to survive and prosper. Customer value is created through the proper sequence of steps occurring at the proper time — the value stream is horizontal. Lean teaches us to focus on the horizontal flow of value and forces us to get out of our silos and evaluate how value is flowing toward the customer."

In the animal feed business, regulations and market conditions have pressured companies to streamline their processes to deliver timely, accurate and cost-effective products to customers while widening profit margins.

Chris Petersen has been director of lean at Ridley Inc., an Alltech company, for nearly two years, bringing his training with the Lean Enterprise Institute and Six Sigma certification to the company's 30 feed mills.

"Lean is not a new term or concept; it's a proven thought pro-

cess, a proven structure," Petersen explains. "There are a lot of tools in the lean tool box, but it becomes more about problem solving and working with employees than the tools themselves."

Petersen explains Ridley has used lean principles to improve customer experience and employee morale.

Building a lean culture

The implementation of lean principles requires a cultural shift from the top down. In the words of James Womack: "It's a lot easier to act your way to lean thinking than it is to think your way to lean acting."

Petersen agrees: "You have to overcome some of those preconceived barriers and change the 'this is how we've always done it' mentality."

He suggests the best start is often opening the discourse to all employees.

"Ask them their opinion on how it could be done better," Petersen says. "This creates trust and demonstrates that their opinions and values matter in trying to improve the business."

He stresses it is a manager's job to create a lean culture to make employees want to contribute to the company's success.

When employees can see that goals are being met as a result of their buy-in to lean thinking, it builds excitement about the process. "Employees want to be part of that [winning] team," he says.

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BENEFIT FROM LEAN PRINCIPLES

Improved customer experience

In an effort to gain buy-in from its employees, Ridley shares all positive and negative customer communications via a message board. Success stories and challenges are also shared at team meetings to "bring the employees closer to the customer," noting that it's especially beneficial for back-office employees, who may never interact directly with clients.

Petersen suggests understanding the customer's expectations and their needs, then evaluating your current processes to figure out what's required and what can be improved upon to close any gaps.

"Operational metrics paint a nice picture. If you understand some of the basic needs, you support it with hard facts, such as on-time service or a quality perspective. You should be able to measure that though customer feedback."

For this reason, Petersen is a proponent of tracking the purpose of customer calls and conducting surveys.

"You can measure the impact of [your continuous improvement program] by how many times that phone is ringing in a day and the reasons why they are calling," he explains. "When your phone calls start to die out, you know you have started to achieve a better result because the customer experiences it."

He admits the results can be mixed because disappointed customers are the most vocal; however, when you start receiving unsolicited, personal letters from customers thanking you for the service that you're providing, you're on the right track.

"Sharing customer feedback empowers employees and prompts them to care maybe a little bit more," he says. "You're not producing a batch of feed — you're producing a product for this customer for this particular livestock that adds value into the food stream."

IN TIME, THE LEAN investment pays for itself in improved customer satisfaction or experience ratings and heightened employee morale.

Lean in action

The implementation of lean methodology often takes little monetary investment because it tends to center around being more efficient within the existing workflow.

Petersen offered five examples of how Ridley was able to use lean principles to improve its operations:

- **Process mapping:** The packing line at one facility was going down five times in four hours at an average 15 minutes per instance. Petersen conducted a process mapping exercise to begin to understand where they were losing efficiency upstream. He discovered the operator was running his line as fast as possible without considering what was happening on either side of him.

  "This individual looked at me and said, 'Chris, you're telling me if I go just a little bit slower, I could get more done?' Yes. Process mapping brought this all to light for us."
- **Beyond manufacturing:** Lean practices, such as 5S methodology (sort, set in order, shine, standardize, sustain), also apply outside of the manufacturing processes of a company. For example, Ridley has a 5S team in its corporate office that uses the methodology to ensure products are replenished and work stations are maintained.

  "We conduct a 5S audit on every employee work station to make sure that things aren't slipping," Petersen explains. "We work with employees to build an efficient work station for their job. We then conduct quarterly audits to benchmark the success of the program."
- **Regulations:** Ridley is exploring ways to apply the 5S tool to recent regulations, such as the Food Safety Modernization Act (FSMA), as it "complements all of our other initiatives to achieve the requirements there."
- **Labeling:** A 35-year employee

mentioned that the labels on his switchboard had worn off over time. Though he knew the switches by memory, the addition of new labels would allow other employees to navigate the machine's controls when he was unavailable. One small step helped make the mill more efficient.

- **Excess motion is waste:** As the demand for a species-specific product increased, the necessary ingredients were still being stored more than 50 yards away from the mixer. The mixing operator recognized this, moved the ingredients closer and evaluated which other infrequently used ingredients could now occupy the storage space.

"Anytime there is excessive motion — the human body moving, walking, lifting, carrying or transportation — how do you get those things as close as possible to where you need them?" he asks. "It can be amazing what simple, low-cost storage alternatives can do for your workflow."

Starting your lean journey

For feed manufacturers looking to implement lean principles in their plants, designated employees could attend one of the many training and certification programs available throughout the country, or the company may choose to hire a lean consultant to evaluate the manufacturing workflow.

In time, the lean investment pays for itself in improved customer satisfaction or experience ratings and heightened employee morale, which in turn, can improve the overall financial or "business health" of the organization.

"A lean transformation does not happen overnight; it will take dedication and continued practice," Petersen says. "I can assure anyone that the efforts will pay off." ■

7 additives to replace antibiotics in US broiler feeds

With the United States entering the fray on antibiotic-free-raised broilers, it is interesting to review what is working so far based on experiences from Europe and what is marketed in the US

BY IOANNIS MAVROMICHALIS

It is no secret that the United States is following the path highlighted by the European Union, at least when it comes to banning growth-promoting antibiotics in broiler diets. In fact, in several well-known instances, the U.S. broiler industry is taking it a step further, refusing to use antibiotics even for therapeutic purposes in what is known as the Never Ever 3 (NE3) marketing program. To make matters worse, coccidiostats are classed as antibiotics under U.S. rules, something the EU has carefully managed to avoid, so far.

All this antibiotic-free experience gained on both sides of the Atlantic has revealed certain patterns when it comes to removing long-standing antibiotics from broiler diets. Of course, feed formulas should change and health should be improved farm-wide, but these are the inglorious works of nutritionists and veterinarians. Somehow, the focus remains on feed additives that can replace antibiotics, sometimes with little regard on the requirements for deeper changes. Nevertheless, these discussions can be summarized in a brief list of alternatives to antibiotics based on my experiences and discussions.

Alisha Winson, Dreamstime.com

1. Organic acids

There is no doubt that the big alternative to antibiotics is organic acids. Free, coated, straight or salts, these compounds have been shown to possess the strongest antibacterial activity. Not all work the same, as their site of action depends on gut pH and the acid's pKa value. Also, they have different potency against the many and varied types of bacteria in the gut. And, of course, inclusion rate is not the same for all organic acids. Here, it merits repeating that adding 1 or 2 kg organic acids per metric ton of complete feed is barely enough.

We need much more than that, but then cost becomes prohibiting, and this low-inclusion level often explains why testing new products is often inconclusive.

» Discover the secrets to antibiotic-free poultry production: www.WATTAgNet.com/articles/26174

2. Probiotics

In the world of poultry nutritionists, probiotics have a very high regard. A recent survey by WATT Global Media revealed that when it comes to replacing antibiotics, probiotics are always in the mix of additives. Sometimes, they are used even in the presence of antibiotics, assuming antibiotics do not kill them. To this end, it pays to ensure that the specific strain of probiotic used to replace antibiotics is not killed or suppressed by other antibiotic-replacing additives. Such could be the case of acid-sensitive probiotic strains.

3. Phytogenics or phytobiotics

These are the same products we used to call "essential oils," but because this group now contains every possible compound that can be found in plants, we changed to a more generic term. They are not used as widely as organic acids and probiotics, at least in the EU, but they are making a very strong entrance in the U.S. market. All together they are viewed, correctly or not, as supplementary to organic acids, if only because clever marketing placed them as potentiating the action of organic acids. This might be true, but is not always the case. For example,

7 ADDITIVES TO REPLACE ANTIBIOTICS

some phytobiotic compounds may interfere with the immune system, whereas others stimulate the digestive system. In most cases, modern products are protected, as some of their comprising elements can be very volatile.

THE FOCUS REMAINS ON feed additives that can replace antibiotics, sometimes with little regard on the requirements for deeper changes.

4. NSP enzymes

Broilers and non-starch polysaccharides (in this case we refer only to beta-glucans and arabinoxylans) are not an ideal combination. The viscosity conferred by high NSP levels tends to slow down digesta passage while at the same time prevents enzymes from entering into the digesta, which results in reduced feed intake and nutrient digestibility. This would have nothing to do with antibiotic replacement if certain pathogenic bacteria did not find a safe harbor in the viscous digesta to proliferate or survive the antibiotic action of feed elements. This was resolved by the strong action of antibiotics, but replacements are not as potent and, as such, breaking down the viscous, gel-like material is considered one step toward effective replacement of in-feed growth-promoting bacteria.

5. Insoluble fibers

Although the NSP compounds mentioned above are part of the "fiber" component of feeds, this group includes beneficial elements such as cellulose (and lignin, which is not an NSP but rather a polyphenol). Lignin is useful only in enhancing gut passage rate, but cellulose can have some further activities. There is some considerable discussion regarding the benefits, dosage and timing of lignocellulose in broiler diets, but all point to the direction of controlling water in the gut resulting in drier excreta — something of paramount importance for litter-raised broilers.

6. Functional fibers

This is clearly a misnomer, previously attributed to another unfortunate term: prebiotics. It includes oligosaccharides (such as inulin to name the most widely known) and certain polysaccharides (for example, pectins) and perhaps any and all types of fiber. Here, our knowledge regarding which types of fiber are effective is rather empirical and based on product-specific knowledge. The general idea is that beneficial microbes thrive on certain types of fibers, and giving them that extra boost will provide

them with an edge over their opponents, the pathogenic bacteria. At least this is the theory, and is perhaps best applied when the feed is enhanced with certain probiotic strains.

7. Copper

Zinc oxide cannot be used in broilers as it quickly becomes toxic. But research has shown that certain copper-containing compounds can have a bacteriostatic or even bacteriocidic effect. In fact, new products are becoming rapidly available to supplement the traditional copper sulphate, which has proven the workhorse of copper so far. Whether organic copper compounds can offer similar advantages is still a matter of discussion as we do not know if it is the higher copper concentration in the blood (systemic effect) or the specific form of certain copper salts (local gut effect) that provides the beneficial effects. Perhaps it is a combination of both.

The discussion about replacing antibiotics should be about five minutes on additives and 55 on the hour about everything else. A high-protein feed will never fail to cause birds to scour no matter what additives we use. The same is true about health: A below-average-health bird will always underperform a healthier one no matter how many additives we include in its feed. But additives are always more interesting to discuss. ■

Benefits of fiber-degrading enzymes in dairy cow diets

The addition of enzymatic feed additives to dairy cow diets increases feed intake, animal performance

BY ALVARO GARCIA AND FERNANDO DIAZ

Fiber-degrading enzyme applications can enhance dry matter digestibility by up to 12 percent.

Constantin Oprus, Dreamstime

High feed costs and mounting consumer concerns about the use of antibiotic growth promoters (AGPs) in livestock production provide ample incentive to revisit and refine the use of enzymes in ruminant diets.

Enzymes can improve feed efficiency and reduce the cost of milk production. Feed additives with enzymatic fiber-degrading activity offer a potential to enhance forage digestion, feed efficiency and income over feed costs (IOFC). The application of a blend of cellulase and xylanase enzyme products to forages (corn silage and alfalfa hay) prior to feeding of 55:45 forage to concentrate diets can increase IOFC from $0.32 to $0.88 per cow daily.

When combining data from 20 studies and 41 treatments that added fiber-degrading exogenous enzymes to dairy cow diets, Canadian researchers reported overall increases in dry matter (DM) intake and milk yield of 2.2 ± 2.9 and 2.4 ± 3.3 lbs/day, respectively.

While the responses to the addition of fiber-degrading enzymes to dairy cow diets vary, the variability is not surprising because most of the commercially available enzyme products that have been evaluated as ruminant feed additives are produced for non-feed applications.

Feed enzymes for ruminants contain mainly cellulase and hemicellulase activities and are of fungal (mostly *Trichoderma longibrachiatum, Aspergillus niger, A. oryzae*) and bacterial (*Bacillus spp.*) origin.

Mode of action

Improvements in animal performance due to the use of feed enzymes have been attributed to increases in feed digestion.

In three studies conducted in lactating dairy cows, fiber-degrading enzyme applications enhanced DM digestibility, 4 to 12 percent, and neutral detergent

fiber (NDF) by 7 to 40 percent.

Three main factors explain the mechanisms by which fiber-degrading enzymes increase digestion and utilization of feedstuffs in ruminant diets:

1. Feeds are structurally very complex, containing a variety of polysaccharides, protein, lipids, lignin, and phenolic acids, often in intimate association.
2. Enzyme additives are usually blends of enzymes with many different actions, each of which differ in optimal conditions and specificities.
3. Ruminal fluid is, by nature, an extremely complex microbial ecosystem containing many hundreds of microbial species and their enzymes. Attempting to identify the individual mode of action of enzymes under such conditions would be nearly impossible.

Scientific review points to enzymes

Data obtained from 24 scientific articles published between 1999 and 2012, which studied the effect of dietary addition of fiber-degrading enzyme products on the performance of lactating dairy cows, included 27 trials and 94 treatments conducted on research stations and commercial dairy farms.

All studies evaluated exogenous fiber-degrading enzyme products with cellulase and xylanase activities, except two of them, which supplemented exclusively cellulases.

Read more: How animal feed enzymes can improve producer profitability: www.WATTAgNet.com/articles/25854

In addition to cellulase and xylanase activities, some enzyme complexes contained ferulic acid stearase, amylase, pectinase or protease activities.

ENZYMES CAN IMPROVE FEED efficiency and reduce the cost of milk production.

Enzymes were added to the diet at feeding time or only a few hours before; therefore, this article does not include trials in which enzymes were applied to forage at ensiling.

Several methods of adding enzymes to the diets were used across the studies. Enzyme products were applied to different portions of the diets including forage, concentrate, or complete, total mixed ration either in liquid or in powder forms.

Furthermore, some experiments compared the different methods of feeding enzymes to dairy cows.

Effects on feed intake

Fiber-degrading enzymes added to dairy cow diets are often accompanied by increased feed intake. This can be attributed to increased palatability due to sugars released on the feed itself before it is fed and/or enzyme effects once in the rumen that result in improved fiber digestibility, gut fill reduction, and increased intake.

Fiber-digesting enzymes increased intake by 2.4 to 7.0 lbs/day in 4 out of 27 of the trials examined (14.8 percent).

Dry matter intake (DMI) was not affected when 5.5 lbs./day of DM of an enzyme blend of cellulases and xylanases were added to the total mixed ration (TMR).

When the inclusion rate was doubled, however, DMI increased by 14.3 percent. In contrast, in other experiments DMI increased

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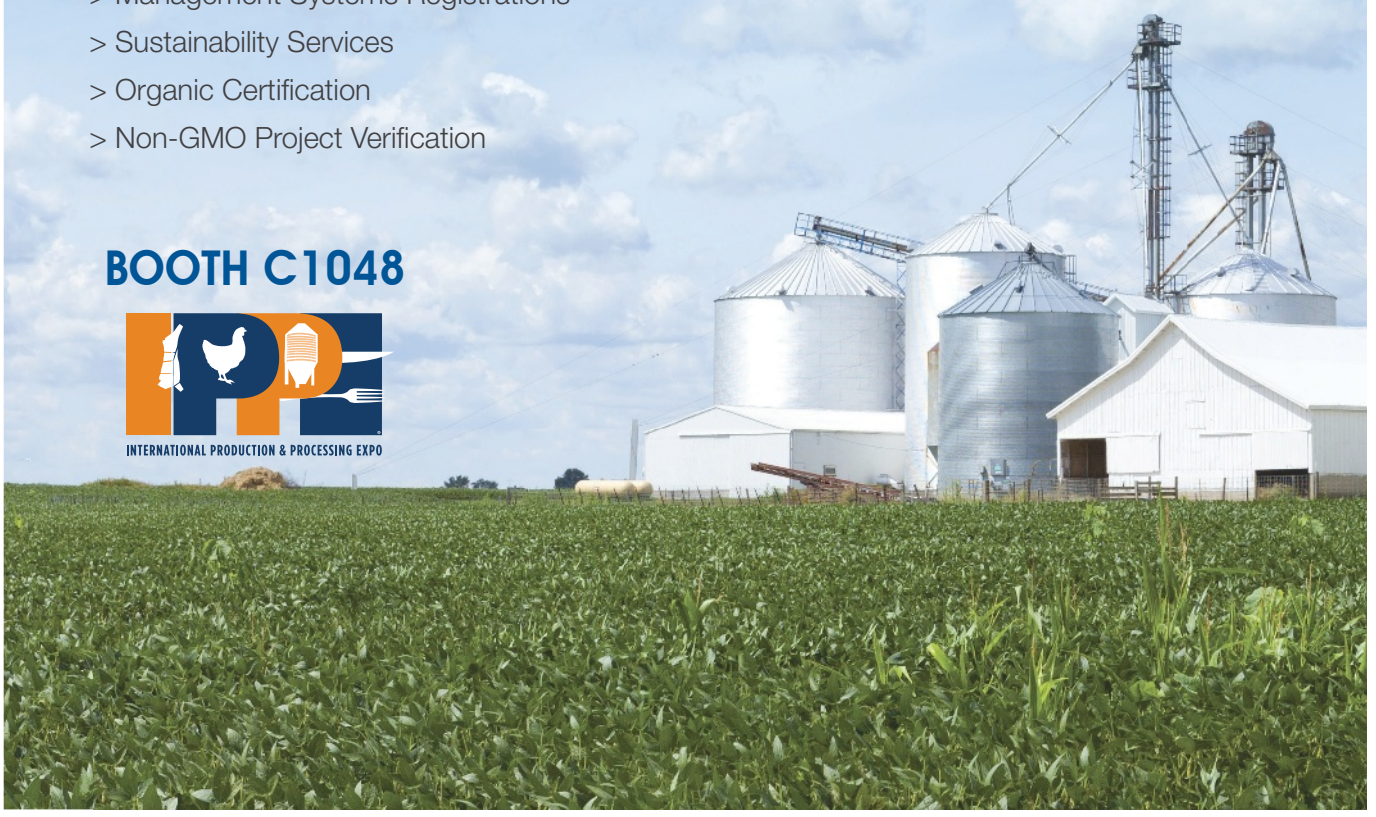

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BENEFITS OF FIBER-DEGRADING ENZYMES

regardless of the enzyme concentration. Moreover, the response of the addition of a fiber-digesting enzyme formulation to diets of dairy cows varied with stage of lactation. University of Idaho researchers detected increased DMI with enzyme addition, in weeks three to seven, but not weeks eight to 16 of lactation.

This difference observed on intake between early and late lactation may be due to the effects of ruminal fiber digestibility on feed intake. In early lactation, cows are usually in negative energy balance, suggesting fill, and not energy demand, regulates intake. Late-lactation cows, on the other hand, are usually in positive energy balance, suggesting energy demand, and not fill, regulates DMI. Therefore, intake of later lactation cows is less affected by increasing ruminal fiber digestibility because rumen fill does not limit intake in properly balanced TMR. ■

References available upon request.

Editor's note: This is the first installment in a three-part series.

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Layer nutrition:
12 perennial points of anxiety

If we were to mention the main nutritional issues faced by the egg industry, we could focus on 12 points that are the focus of nutritionists, genetic companies, feed mills, veterinarians and, of course, farmers.

Photo courtesy of Farmer Automatic

BY IOANNIS MAVROMICHALIS

Every nutritionist involved in layer nutrition has come across several problems that we can summarize in the following brief list. Not only do these problems keep showing up constantly, but for most of them we do not have a satisfactory solution.

1. Eggshell quality remains the major issue

This is a multi-factorial problem that has deep roots in early layer nutrition. The major issue is that, as the hen ages and tends to produce a large egg, she cannot spare extra calcium, ending up producing an ever-thinning eggshell. To make matters worse, the efficiency by which she absorbs calcium from feed drops considerably. It is only by means of controlling egg size, preserving and even boosting calcium absorption capacity and monitoring actual calcium levels in the feed that this problem can be addressed.

2. Egg size is a double-edged problem

Fresh-egg markets prefer a large(r) egg, but this comes with a thinner eggshell, and it might drain the

Understanding daily calcium cycle in layer hens
www.WATTAgNet.com/articles/25083

hen from body reserves of energy and protein if her nutrition is inadequate. Most producers prefer to limit the upper egg size to ensure a longer egg cycle, but others invest in less but heavier eggs. The main means toward both goals is protein and especially methionine nutrition.

3. Summer heat distress has not been resolved

During heat waves, hens will eat less and produce fewer and smaller eggs. This issue is best addressed by proper facilities and management, but nutrition can also play a role. Primary attention should be paid on feed electrolyte balance, but certain additives, especially through the water, can be administered to alleviate the problem. Feeding during cooler hours (night) is not an easy proposition as it interferes with the egg formation cycle.

4. The dilemma of a pre-layer diet

Most farms feed a pre-layer diet that is high in calcium to ensure early egg production does not deplete hens, but some don't because this might predispose hens to early renal failure from calcium overdosage. A high calcium pre-layer diet also contributes to high(er) water intake throughout the egg cycle, something important for layers housed on litter.

5. Pellets, mash or crumbles?

This is a much-asked question, and it really has no single answer apart from the recommendation to test what works best under the conditions of each farm. Mash is cheaper, but it can separate. Pellets are recommended for low-appetite strains, but they are more expensive. Crumbles seem to work best in most situations, but they are very expensive.

6. Sticky, wet, dirty litter

Water overconsumption combined with viscous cereals in the feed cause sticky droppings that refuse to lose their water through evaporation. This is not such an issue in cage-housed layers, but when they are housed on litter it becomes a major issue that affects hen health and welfare and gives issue to dirty eggs. Understanding why hens might consume more water than they need (feed electrolyte balance and protein are the major nutrition issues) and addressing feed viscosity seem to resolve this problem, unless it is a major disease problem.

7. Finding the right yolk color

Pale egg-yolk color is undesirable in the fresh-egg market, whereas an overly red one is also suspicious. Finding the right point is an exercise of balance

between natural and synthetic pigments. Where synthetic pigments are not preferred, natural intense pigments can be sourced from less conventional ingredients.

8. Feather picking

This remains a problem in caged layers, mostly out of boredom and (or) lack of space, but it can also happen in cage-free hens if their diets are low in protein or specific amino acids. Checking the mineral and amino acid profile of a diet will quickly reveal if this is a nutrition problem or something that needs to be addressed through management. Some additives might offer limited relief from this problem.

9. Cage layer fatigue

High-producing strains confined in cages often suffer from this syndrome, especially if their bones are depleted of calcium due to nutritional imbalances. Affected hens become progressively paralyzed and die from hunger as they move to the back of the cage. A pre-layer diet with the correct level of calcium seems to be helpful especially if it is targeted along the appearance of sexual maturity.

10. Fatty liver syndrome

When hens overeat their daily allowance, or when there is not enough protein in relation to protein/amino acids in their feed, the excess energy is deposited as fat. Excess fat in the liver is easily oxidized, leading to hemorrhages and general liver dysfunction and to reduced productivity, health and longevity. Restricting feed intake is not easy because not all birds will over-consume feed. It is by balancing the energy-protein ratio and by adding nutrients and additives that will help "dissolve" the fatty liver that this problem can be addressed by nutritional means.

11. Calcium is the most discussed nutrient

When one wants to know about layer nutrition,

calcium should be the starting point. Understanding the daily calcium cycle, from calcium in the feed to calcium in the eggshell, and the recycling of calcium in bones, is the cornerstone of calcium nutrition. In addition, deciding on the optimum source of calcium, its form and granular size and, finally, the time of supplemental calcium feeding, all are important aspects of this delicate subject. The role of phosphorus and vitamin D are two further aspects that are often overlooked, but these two nutrients interact with calcium absorption and utilization and must be monitored.

12. Genetics and book dietary specifications

Genetic suppliers always offer sound nutritional background information on how to best feed their layers. In most cases, these are a mix of scientific and empirical evidence, but by nature they are best estimates or averages. Some producers and nutritionists prefer to follow these guidelines to the letter, if only not to be blamed when something goes wrong. Others, with more experience, prefer to use these recommendations as guidelines and starting points based on which they can customize the nutrition program of each layer farm.

Mash or cumbled feed for layers?
www.WATTAgNet.com/articles/18521

Layer nutrition is not limited to the above 12 points, but these constitute a good reference list for the most common issues. Each point is worth further analysis and study, and nutritionists, researchers and producers are working hard to find better solutions. ■

Understanding rice bran in pig, poultry feeds

Rice bran is an atypical ingredient: It has excellent nutritive value, but it is undervalued by most nutritionists and the commodities market.

BY IOANNIS MAVROMICHALIS

Rice bran is a misnomer, or rather a confusing term because it can encompass a range of rice byproducts at variable concentrations. But rice bran it is, and this name has prevailed in literature and commerce. It is a very atypical ingredient: It has excellent nutritive value, but it is undervalued by most nutritionists; it is widely available, but hardly traded in the commodities market. Understanding how rice bran is produced and its problems will help nutritionists seek out this eccentric ingredient and use it in pig and poultry diets with confidence.

» 5 guidelines for alternative animal feed ingredients:
www.WATTAgNet.com/articles/28760

Palagiri

The rice milling process

It all starts with rice grain as it arrives from the field. The rice we grow and the rice we humans eat do not look the same. Field rice comes with a tightly attached outer husk or hull, very much like barley and oats. Removing the hulls is the first step in the rice milling industry. Unlike other similar cereals, rice has hulls extremely rich in silica (silicon dioxide), better known as quartz or sand. As such, rice hulls are immensely abrasive not only on the feed mill machinery, but also inside the animal.

Consumption of rice hulls at sufficient quantities can cause diarrhea (best case scenario) and in-

Rice bran can be a valuable ingredient if it is of high-quality origin.

ternal bleeding (worst case scenario). Obviously, the damage increases with ingested volume. As such, it strongly prohibits using rice hulls in diets for pigs and poultry — even at the slightest concentration. Most rice mills use rice hulls as a source of energy as they burn it to produce heat or electricity, or both. Lamentably, some mills incorporate some part of their rice hull production into rice bran, and this is the first reason why some such products fail. To this end, it is recommended to test incoming rice bran for silica according to volume and frequency of loads.

When the hulls are removed, we are left with a brownish grain — also known as brown rice. This looks very much like wheat, and like wheat, it is very hard to boil and chew. Thus, the outer brown layer, which is rich in fiber (the hard-to-chew part), is removed. This is the actual "bran," again equivalent to wheat bran, even in the profile of the fiber: It is rich in pentosans, especially arabinoxylans. Because of this, it should be equally beneficial to use a wheat-specific enzyme when high levels of rice bran are used. Most likely, this is going to benefit more poultry than pigs, but all these assumptions require documentation.

Further down the rice milling process, the embryo is removed. Rice grain is a seed, after all, and contains an embryo that will give a new plant — the rest are its first food. This embryo is rich in protein and oil. Removing them leaves the rice we consume, which is practically a starch-rich staple. In some instances, especially in Asia, rice oil is extracted, but in most cases, the embryos are blended with bran. This is a desirable process, but it can also be the root of many troubles. Along with the oil, there are a good amount of enzymes that oxidize it (used by the new seedling to obtain its first energy "drink" before starch is mobilized from afar). These lipoxidases start acting as soon as they are exposed to the air, and this happens when the embryos are torn apart during the milling process. Thus,

Indiatraveler, Dreamstime.com

Field rice comes with a tightly attached hull that is rich in silica.

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rice bran contains high levels of oil, which gives it high nutritive value for animal feeding, but this oil might be highly oxidized, which causes feed refusal by animals — especially young ones. To prevent this, an antioxidant should be added at the rice mill, but this is seldom done, perhaps due to cost or lack of mixing abilities. If unprotected, full-fat rice bran (as it is often called) will oxidize rapidly unless it is consumed within days from its production.

Removing the outer hull leaves a brownish grain.

Airborne77, Dreamstime.com

The final product

To arrive at the highly glossy rice we buy at the supermarkets, rice mills must polish the final product. This is achieved by friction using calcium carbonate. This is why when we rinse rice before cooking it the water is cloudy. The amount of calcium carbonate used is minimal, but it should be taken into account as this mineral is used in many nutrition products, such as soybean meal to increase flowability, and vitamin, mineral and medicinal premixes as a carrier and diluent. Thus, calcium laboratory analysis is required to ensure the correct calcium level is entered in the feed formulation matrix. Rice polishing leaves behind a dust of calcium carbonate and starch, which are again added into wheat bran, without diminishing its quality — but they come at a very distinctly finer particle size, so separation could be an issue if embryo-derived oil is not in the mix to keep everything "in suspension."

The final thing we must be aware of rice bran is that it is a cereal rich in phytate. In other words, it contains negligible amounts of digestible (pigs) or available (poultry) phosphorus. Only 12 percent of total phosphorus is of any use to these animals — the rest is excreted in the manure. Adding the enzyme phytase will most likely benefit any diet containing rice bran, but perhaps an extra dose might be warranted — again a

UNDERSTANDING RICE BRAN

very nice theory that requires input from those most interested in this business: the phytase suppliers. As it stands, rice bran-based diets require increased supplementation with phosphates (mono- or di-calcium phosphates), which should not be a problem for most mills, unless a concentrate of micro-ingredients already containing phosphate is used. In this case, the mill will need to provide for an additional/occasional ingredient: a phosphate to be used in diets rich in rice bran.

In conclusion, rice bran is a valuable ingredient as it contains about 14 percent crude protein, 7 to 10 percent crude fiber and up to 17 percent oil. This gives it a net energy concentration of 10 MJ/kg for pigs, and a metabolizable energy of 11.5 Mj/kg for poultry. Absence of any hulls and stabilization of the oil will ensure a high-quality product that can be used at levels restricted only by its fiber concentration in all diets for pigs and poultry. ■

Andrey Ospishchev, Dreamstime.com

White rice is a polished grain that is mostly starch.

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10 practical piglet gruel feeding guidelines

A feeding method recommended for underprivileged piglets that requires attention to details but pays dividends in speeding up the growth of small-for-age weaners

BY IOANNIS MAVROMICHALIS

Gruel feeding is a management practice that targets the bottom 10 to 20 percent of small-for-age piglets in any weaning group, regardless of weaning age. Of course, the greater the weaning age, the fewer the pigs that require or rather benefit from gruel feeding. In general, research and commercial experiences have indicated that gruel feeding offers four distinct advantages when done correctly:

1. Enhances ingestion of nutrients, especially during the early days post-weaning
2. Allows a smoother transition to dry feed, especially when the feed is pelleted
3. Prevents damage of the gut due to soybeans or prolonged starvation

Noah Browning, Dreamstime.com

Piglets will instinctively investigate any moist-liquid material within their reach, making gruel feeding a natural feeding method.

4. Promotes hydration, an extra and very significant benefit, particularly in sick piglets

Of course, for all these to succeed, gruel feeding needs to be done according to high(er) standards of hygiene. It is usually a labor-intensive task and requires staff dedicated to assisting underprivileged piglets. Below is a 10-step guideline for efficient and practical gruel feeding.

1. Use large, open bowls or lockdown circular feeders. In general, the larger plastic feeders offer the best results as they allow communal feeding.
2. Place the gruel feeder near the feeder with the dry feed, avoiding pen corners, waterers, sleeping mats and heat lamps.
3. Place a small amount of dry feed in the normal feeders from the first day, even though piglets may appear to ignore it. Use the same formula/product that is used in mixing the gruel.
4. A strong flavor with a distinct aroma in the product used in mixing the gruel and in the dry feed is believed to help piglets associate dry feed with nourishment.
5. Offer gruel at least three times per day, starting with a mix of 1/4 dry feed and 3/4 water in a large bucket for all pigs or directly in each feeder.
6. Using warm water or liquid milk replacer may also be used to create a gruel. In fact, the latter is believed to promote even higher intake, but this might

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not be needed if the dry feed is already high in dairy products.

7. Feed enough gruel for pigs to clean up in a single feeding episode. If gruel is left uneaten, remove it, clean the feeders and reduce allowance in the next feeding.
8. Gradually thicken the gruel to 2/3 pellets or meal and 1/3 water. This will allow piglets to turn to dry feed easier and faster.
9. Gradually reduce the number of feedings per day and discontinue by Day Four or Five after weaning. Again, this is done to convince piglets to convert to dry feed. The exact timing should be determined by the people who actually do the feeding because they can determine when each pen no longer requires gruel to thrive.
10. Make sure pigs have access to fresh water from Day One from drinkers. For underprivileged piglets, a bowl-type drinker is believed to give better results, whereas some prefer to use nipple water drinkers that allow to dribble during the first day or so.

Typical five-day program for feeding gruel to fall-back pigs

The table provides an example of a commercial gruel feeding program. It is not the only schedule possible, but it is one that provides good results in most farms. Usually, gruel feeding is discontinued by the third day post-weaning, although in pens with sick pigs it might be extended to seven days or longer.

Commercial gruel feeding program example

Day	Mix (water:feed)	Feedings per day
1	75:25	3
2	50:50	3
3	50:50	2
4	25:75	2
5	25:75	1

An example of a commercial gruel feeding program that provides good results in most farms.

When pigs only drink the water and leave the feed

Sometimes, especially during the first couple of days of gruel feeding, pigs may drink only the liquid (water) and leave a paste of feed at the bottom of the feeder. This indicates the pigs are particularly thirsty, and an alternative way of providing water must be provided. Replenishing the feeder with more water usually results in consumption of the remaining feed.

Avoid a second weaning

One of the most discussed problems of gruel feed is that piglets love gruel too much. In fact, they like it so much that if they can have enough of it, they will not consume dry feed. So, it is important to offer them just enough gruel to sustain them without satisfying their hunger. This will force them to seek more nutrients from normal (dry) feed.

It is important to reiterate that this dry feed should be the exact same product used to mix the gruel. In addition, a gradual change from gruel-supplemented nutrition to all-dry feed is recommended. Such a program is presented in the table, which can be adapted according to requirements.

Is there an ideal product for gruel mixing?

There are some dry products (powders) that are sold to be used in gruel. Most of them are very similar to a milk powder replacer, which serves the purpose of gruel feed: forcing piglets to consume dry feed within the medium of the "soup."

A liquid milk replacer has a different role. In general, it is considered best to use the creep feed (offered during the lactation period) or the first diet post-weaning (sometimes these two can be the same). It is not a bad idea to buy a diet of higher quality to be used as gruel for underprivileged piglets than that used in the rest of the weaning group.

The extra expense, if associated with higher quality, usually pays back dividends by speeding up these small-for-age pigs to reach the performance of their heavier counterparts by the end of the nursery period. ■

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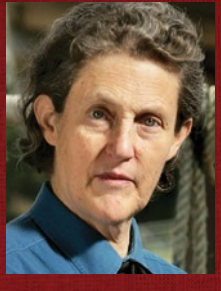

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