

Gain An Edge In The Evolving Livestock Feed Market

5 Innovative Natural Ingredients And How They Address Emerging Agricultural Challenges

A Special Report For Livestock Feed Manufacturers

Garuda, International

March 2014

Introduction:

Today's Farmers Are Looking For Your Products

In Iowa, Karl, a hog-finishing farmer sees a growing demand for his pigs. But he's having difficulty expanding his operation despite owning enough land to do it. His neighbors have put up a battle to expanding his operation because they don't want the odor seeping into their backyards. They're worried they won't be able to open their windows and their property values will go down.

This farmer's not alone . . . across the country, pig, poultry and cattle farmers face steep local opposition to their operations because of the ammonia smell associated with their farms.

In Pennsylvania, Matt is living out his dream owning a whitetail hunting operation. He knows there's a devoted market of hunters looking for a rewarding hunt. But to attract their attention, he's got to be able to deliver on bucks with big antlers. If he can only hit on the right nutrition program to help him grow these bucks on his ranch, he knows he'll be able to make his ranch profitable.

In Wisconsin, Bea has decided to take her family's dairy operation in a whole new direction. She's hoping to cash in on the premium prices available for organic milk. But managing a herd, keeping them healthy and productive, without the conventional approach is a challenge. She's watched other farmers make this conversion and knows she can do it. But she also knows she'll have to make some careful investments in upgrading her feed strategy.

These stories represent some of the challenges farmers and ranchers face today.

They also explain the changing livestock feed market. According to a 2013 report written by Frost & Sullivan market analyst, Christopher Shanahan, the demand for natural ingredients for livestock feed is growing. In 2012, it was estimated to be worth close to \$12.9 billion and is projected to grow at a CGAR of 5.1% to \$17.28 billion in 2019.¹

Increasingly farmers are searching for livestock feeds that tap into the power of natural ingredients. And – as the 2013 report notes – many of these ingredients not only meet their demands but even surpass the effectiveness of their conventional counterparts.

¹ Shanahan, C. Special Report: Analysis of the Global Animal Feed Ingredients Market. Virgo Publishing. Nov 2013.

Three major reasons drive this burgeoning interest in natural ingredients. These ingredients are helping farmers and ranchers . . .

1. Meet a growing consumer demand for natural and organic eggs, meat and dairy products;
2. Increase profitability by helping to control costs and produce better products more efficiently.
3. Become more welcome as neighbors and expand operations – by helping control of odor and ammonia pollution.

Agriculture is evolving in response to changes in consumer demands, regulations and the larger farming environment. By integrating natural ingredients strategically into your formulations, you can become an invaluable partner in agriculture business' success.

Natural Ingredient Driver #1:

The growing consumer interest in “natural” meats and animal products

With a growing public distaste for the use of antibiotics and hormones in the production of meat, eggs and dairy products, the grocery store is changing. Stockers are pushing aside the old brands in the refrigerated cases to make room for naturally-raised bacon, grass-fed beef, hormone-free milk and free-range eggs. Even popular restaurant chains like Chipotles and Burgerville are hawking their commitment to “natural” meats.

Organic and naturally-raised meats are quickly working their way into the mainstream. And farmers are eager to take advantage of this growing, premium-priced market. But making the transition requires not just getting rid of the old. It requires integrating new nutrition that can help them keep their livestock healthy and maintain productivity.

A few key groups of nutrients have taken center stage in helping farmers make this shift. In particular, farmers are looking to ingredients that help support strong immune systems and overall animal health, precluding the need for antibiotics.

For example, the mineral **selenium** is fast becoming recognized as an important feed additive due to its absence in many soils. Says USDA Agricultural Research Services soil scientist Gary S. Bañuelos. "Selenium deficiency is a major problem for livestock or wildlife in at least 37 states and costs beef, dairy, and sheep producers an estimated \$545 million in losses every year."² Even selenium-rich soils may produce selenium-poor forage since commonly-used sulfate and phosphate fertilizers bind selenium and limit uptake in crops.³

Selenium plays a critical role in the efficiency and effectiveness of all aspects of the immune system. It is key to the operation of both the adaptive and innate immune system.

Researchers are still learning the full implications of how selenium boosts immune health and health overall. But as one article published in *The Journal of American Society for Nutritional Sciences* noted, “there is no doubt that low dietary intakes of selenium and consequent deficiencies in farm animals can result in a wide range of diseases.”⁴

When selenium is added back into the picture with strategic supplementation, farmers see impressive results.

² Kenaf and Canola – Selenium Slurpers. United States Department of Agriculture Agricultural Research. June 2000.

³ Lee S et al. Effect of phosphate and sulfate fertilizers on selenium uptake by wheat (*Triticum aestivum*). *Soil Science and Plant Nutrition*. Oct 2011. 57:696-704.

⁴ Arthur JR et al. Selenium in the Immune System. *J. Nutr.* May 1, 2003 vol. 133 no. 5 1457S-1459S

- Selenium has been shown to increase weight gain in calves, support udder health and healthy births in dairy cows.⁵
- With pigs, selenium reduced stillbirths, increased birth weight and weight gain.⁶
- In poultry, selenium improved fertility, weight gain, egg production and reduced health issues like ascites and heat stress.⁷
- Selenium has been shown to make a significant difference in fish growth, muscle development and overall health.

Prebiotics have also grabbed the livestock feed market's attention. With the rise in consumer demand for antibiotic-free products and the 2006 EU ban on antibiotics in animal feed, researchers and farmers have been searching for alternatives. Prebiotics have been identified by researchers as a potential product for filling this gap.⁸

Prebiotics are fibrous oligosaccharides found in a variety of plants like chicory, Jerusalem artichoke and agave. It's the food of choice for beneficial probiotic bacteria. Mostly found in the hindgut of animals, probiotic bacteria enhance digestion, support immune strength and produce key nutrients necessary for good health. By simply taking up space and producing unsavory metabolic byproducts like lactic acid, probiotics make the gut unwelcome to pathogenic bacteria.⁹

According to a Frost & Sullivan report, the demand for prebiotic ingredients for animal feed could be as much as \$429.3 million by 2018.¹⁰ In a market where an "antibiotic-free" label can make the sale at the consumer level, prebiotics' potential role in helping to keep animals healthy is a huge advantage.

But while these ingredients are helping farmers break the ties with antibiotics, they're not just for natural and organic farmers. Conventional farmers are also taking interest in how some of these natural ingredients can boost their farming operations.

Driver #2: Healthier animals reduce costs and produce better products

Farmers and researchers are learning strategic supplementation can improve feed efficiency, lower costs and boost product quality overall. Prebiotics and selenium are used by conventional farmers as well as natural/organic farmers for all these reasons.

⁵ Spears JW et al. Role of antioxidants and trace elements in health and immunity of transition dairy cows. The Veterinary Journal, 2008; 176: 70-76

⁶ Lyons et al. Selenium in food chain and animal nutrition: Lessons from nature. Asian-Aust. J. Anim. Sci. 2007. 20(7):1135-1155

⁷ Lyons 2007

⁸ Hajati H et al. The application of prebiotics in poultry production. International Journal of Poultry Science 2010. 9(3): 298-304.

⁹ Hajati 2010.

¹⁰ Prebiotic Ingredients Market (FOS, GOS, MOS, Inulin) for Food & Beverage , Dietary Supplements & Animal Feed – Global Industry Analysis, Market Size, Share Trends, and Forecast, 2012-2018. Transparency Market Research. February 2013.

- More conventional poultry feed products are including prebiotics. While the research has yielded mixed results, there are some indications prebiotics may help with feed efficiency and weight gain. One study showed prebiotic-fed chickens had an average of 6% increase in weight gain over the control group.¹¹
- Selenium may help conventional farmers get more for their products when they reach retail. Selenium supplementation has helped with meat yield by reducing the drip rate of meat while it matures. At some point, selenium supplemented feed may help attract specific consumer markets since research indicates it helps increase meat tenderness and antioxidant levels. Dairy farmers find that selenium supplementation translates into richer concentrations of selenium in milk. As awareness of the FDA-approved health claim linking selenium to protection against cancer increases, farmers may start to promote their milk as a good source of selenium.

Calcium is also being added to feed formulations to improve results. Found in increasingly short supply from forage, calcium is essential for animal health and quality production. From hard egg shells to sturdy calves, adequate calcium supply in feed can make the difference.

In addition to its ubiquitous use by farmers to boost productivity, calcium provides a great illustration of how certain natural ingredients can become strategic tools in helping specialized farmers and ranchers grow their businesses.

One particular group of ranchers is eagerly on the lookout for the best, most bioavailable form of calcium possible. Only a few feed companies cater to this group. Yet for the manufacturers who develop products for them, they represent a solid, passionate group of customers.

Who are these farmers absorbed in discussions of calcium? Whitetail deer ranchers.

With over \$14 billion dollars spent in 2010 on travel alone in the hunting industry, whitetail ranchers are eager to attract sportsmen to their properties. And what brings hunters halfway across the country to a ranch on the Texas plains or the Pennsylvania woods? The promise of a buck with a big rack of antlers.

In order to produce large antlers each year, deer need to be in good health with a healthy supply of bioavailable calcium.

As whitetail ranchers search for the best calcium product to feed their deer, many are choosing **milk calcium** over calcium carbonate.

Research has yet to be done on the advantages of using milk calcium specifically for white tail antler development. Nonetheless, anecdotally, many ranchers swear by the use of milk calcium supplementation for helping them grow bucks with antlers that draw hunters. This is consistent with other research indicating dairy-sourced calcium is much more easily assimilated by animals than

¹¹ Hajati 2010.

inorganic calcium carbonate.¹² Given that antlers are one of the fastest growing body parts in the animal world, requiring tremendous mineral nutrition, milk calcium may indeed give these ranchers an edge.

Many whitetail ranchers have decided that feed with this ingredient is essential for cultivating the kind of products that can strengthen their business. And they're looking for products that include it.

Farmers and ranchers are eager to find ways to make their operations more cost effective and their products more attractive to their markets. These ingredients can help them do this. But increasingly, farmers face another challenge as well . . . staying friendly with the neighbors.

Driver #3: Alleviating environmental and waste management concerns

Problems associated with farm waste have become the focus of environmental organizations and zoning boards alike. And when it comes to neighbors, a 2009 study conducted by Michigan State University researchers found, after a review of data from 1998-2007, odor was the most frequent complaint lodged against farmers in Michigan.¹³

But of course you don't need a study for that. Anyone who's visited, worked, or lived on a farm knows they have distinct smells.

Farmers are concerned about this problem for a number of reasons. First, without question, they'd like to be welcomed in the neighborhood. Reducing the odor and other potential hazards of ammonia buildup is essential for this. Complicated ventilation systems and special slurry treatments may help solve this problem.

But a particular group of ingredients may help stop the problem before it starts by going right to the animal's digestive system.

Extracts from saponin-rich **Yucca** and **Quillaja**, seem to significantly reduce ammonia buildup in farming operations.¹⁴ Researchers are still trying to zero in on exactly how these saponins do this, but it seems their effectiveness is linked to the way they destroy cholesterol. When these saponins dissolve the cholesterol in the cell membranes of ammonia-producing protozoa found in the gut, they destroy the protozoa. And when the protozoa are killed off, so goes the ammonia, too.

When it comes to global arguments against meat and dairy production because of their links to methane gas production, Yucca may also help farmers lay them to rest. Research indicates that a small amount of Yucca supplementation can reduce the amount of methane produced by ruminants by close to 60%.¹⁵

¹² Weaver et al. **Dairy vs. Calcium Carbonate in Promoting Peak Bone Mass and Bone Maintenance During Subsequent Calcium Deficiency.** *Journal of Bone and Mineral Research*, 2009.

¹³ Odors a top farm-neighbor complaint. Hobby Farms Magazine. May, 2010.

¹⁴ Miller D. Odor Busters. National Hog Farmer. Sep 15, 2003.

¹⁵ Belke, E. et al. (Animal Science Department, University of Lincoln Nebraska). 2005. Unpublished results. Viewed 3/1/14 at <http://www.sartec.com/pdf/newsletter/Issue51.pdf>

But keeping up friendly relationships with neighbors isn't the only benefit of these feed additives. Reducing ammonia in farm operations offers other health benefits that tie back to productivity and cost-savings.

Too much ammonia has been linked to reproductive issues, animal mortality and poor feed efficiency. When it comes to increasing productivity and cost savings,

- Research has linked saponin use to reducing piglet stillbirths, calf mortality and increasing conception.
- Trials on calves, steers and broiler chicks indicate these saponins help with weight gain and feed efficiency for an initial period of time.

In addition to their role in reducing noxious ammonia, some research indicates saponins' impact on feed efficiency may be linked to how they balance out gut microbial populations and increase the permeability of the small intestine.

Natural ingredients like Yucca and Quillaja are making it easier for farmers to expand operations while avoiding conflict with the people who live nearby.

Conclusion

Farming is a tough business to be in. Given the huge variables in weather and markets and the often slim profit margin, farmers are eager to find inputs that make sense. Feed ingredients that offer them an edge in their markets, cost savings or an easier time maintaining and expanding operations are more than welcomed.

As the 2013 Shanahan report acknowledges, more and more livestock producers – both conventional and natural/organic - are looking for answers in natural ingredients.

Natural ingredients can

- Eliminate the need for conventional inputs like antibiotics;
- Boost feed efficiency and product quality; and even
- Pave the way to better community relations locally.

Farmers are looking for formulations that include these inputs strategically and effectively. As farming science continues to become more refined with better soil testing, forage assessment and shifts in feeding strategies, targeted feeds that specifically meet different markets' needs will also gain attention.

The key is to use quality ingredients that justify the expense by performing as promised and offer assurance of safety. Paying attention to quality control will also help with new FDA regulations requiring state inspection agencies to standardize their criteria for pet and livestock feed manufacturing.¹⁶

¹⁶ Huffstutter PJ et al. Federal program aims to make pet food, livestock feed safer. Reuters Feb 2014.

Garuda has a long history of providing safety-tested and identity-confirmed ingredients for the worldwide food and beverage industries. We've extended these standards to how we manage our livestock ingredients as well. With the high quality ingredients we offer, you can help your product developers match the shifting interest in the feed market.

And carve a solid space for your business to grow in.

About Garuda

Major manufacturers and small niche businesses in more than 30 countries rely on Garuda International for high quality natural ingredients to make their products shine. As Garuda founder and CEO, J. Roger Matkin puts it, "To achieve success, one must create success for others." With this philosophy forming the foundation for how it conducts business, Garuda has maintained an unerring commitment to bringing safe and excellent ingredients to the industry.

By working closely with their international partners, Garuda ensures each of their 80+ products meet their clients' standards. In addition to third-party testing to ensure identity and safety, Garuda regularly makes field visits and audits their suppliers to ensure ingredients are harvested and processed correctly. Furthermore, thanks to its close relationship with suppliers, Garuda is able to maintain a consistent supply of each ingredient, helping clients maintain their manufacturing schedules without a hitch.

Finally, Garuda is a pioneer, always on the lookout for new ingredients that open the door to innovation. With the help of its partners, Garuda developed and introduced COWCIUM® milk calcium and LesstanoL® natural ocatacosanol and policosanol to the U.S. market.

Garuda has been supplying natural product manufacturers for more than 30 years. Committed to the growth and development of the natural products industry, Garuda holds memberships with NNFA, IFT, AHPA and the American Botanical Council.

Eager to see how Garuda International can help your natural product business? Please contact our sales team at +1 (559) 594-4380 or feedingredients@garudaint.com.

Or go to www.garudaint.com to learn more about us online.

We look forward to helping your business succeed!

Sidebar 1:

Not Just For Livestock – The Growing Natural Pet Food Market

You can't help but notice the shift, pets are now embraced as a full member of the family. And with that new rank, comes new food standards as well. Increasingly, pet owners are willing to pay premium prices to make sure their pet food keeps their furry friends healthy.

With this kind of passionate consumer interest in getting the right foods for their pets, this market is growing in leaps and bounds. Packaged Facts predicts the natural pet food market will continue to boom at a healthy 10-15% rate of growth annually between 2014 and 2017. They predict it will reach \$9.4 billion by 2017.¹⁷

Many of the ingredients used for livestock feed can be translated into the pet food market.

- Both pet food and kitty litter manufacturers have started adding Yucca to their mixes to help pet owners breathe easier. When added to dog and cat food, Yucca extract reduced bad odor in their feces by up to 56% for dogs and 49% for cats¹⁸ The same researchers found that ammonia was reduced by as much as 81% in the litter of cats fed this saponin-rich extract.
- Pets who are on high protein diets are particularly susceptible to the growth of pathogenic bacteria. In addition, these pathogenic bacteria – like Clostridium - continue to thrive on the undigested protein that makes it into the animal waste on the other end. And these bacteria help produce the foul fecal odor dogs and cats tend to leave in their wake. Prebiotics added to dog food have been shown to reduce the odor-causing compounds found in feces. And studies have also indicated they could strengthen digestive and immune health, particularly in weanling, stressed or geriatric dogs.¹⁹

More pet owners are reading pet food labels meticulously. And pet food manufacturers are reaping the rewards when they respond to this passionate interest in pet health.

Sidebar #2:

Feeding It To The Fishes: Natural Ingredients In Aquaculture

For decades, aquaculture focused mostly on meeting protein requirements for healthy growth. Now, however, micronutrients are taking their place as a critical point in feeding strategy.

And among those nutrients, selenium yeast takes center stage. As with humans and other land-based livestock, selenium is essential for fish immune health. However, its value doesn't stop there. Fish need adequate selenium for healthy growth, reproduction and muscular development as well.

As a bonus to consumers concerned about having enough selenium in their diets, fish raised with adequate selenium supplementation, have higher levels of selenium in their flesh.²⁰

In addition to the established health benefits associated with immunity and growth, new preliminary research indicates selenium-rich proteins may bind with mercury and inactivate it, reducing or

¹⁷ Market for natural pet products expected to skyrocket. Pet Product News International. Nov, 2012. Viewed 3/1/14 at <http://www.petproductnews.com/headlines/2012/11/06/natural-pet-products-market-growing.aspx>

¹⁸ McFarlane et al, 1988

¹⁹ Swanson, KS et al. Supplemental fructooligosaccharides and mannanoligosaccharides influence immune function, ileal and total tract nutrient digestibilities, microbial populations and concentrations of protein catabolites in the large bowel of dogs. The Journal of Nutrition. 2002.

²⁰ Sweetman J. Aquaculture turns eye on organic selenium. Feed Mix April, 2008. 16(1)

eliminating its toxic impact on the body.²¹ With mercury contamination in seafood as a significant source of concern for consumers, this research may bolster the reasons to add selenium supplementation.

Yucca and Quillaja saponins have also been researched for their use in aquaculture. In one USDA study, saponin additions did not seem to have any affect when it came to tilapia culture. But it significantly increased shrimp growth and feed efficiency²². While this study did not note improved water quality from Yucca supplementation, other research has demonstrated a decrease in ammonia levels with Yucca extract addition to shrimp feed.²³

While results on studies with Quillaja have been mixed, research involving carp and tilapia aquaculture have shown it can contribute to an overall increase in weight gain and feed efficiency. One trial on carp found Quillaja supplementation at a concentration of 150 mg/kg resulted in 37.5-73.2% increase in average body weight over controls.²⁴

With the mounting consumer taste for seafood, aquaculture is growing, too. Aquaculture operations are keenly interested in feed supplements that can help fish farms increase their yields and the quality of their products.

²¹ Dietary selenium protects against selected signs of aging and methylmercury exposure. *Neurotoxicology*, 2010;31(2):169-79

²² Feeding of Nile Tilapia *Oreochromis niloticus* and White Shrimp *Litopenaeus vannamei* with different diets supplemented with Yucca schidigera and Quillaja saponaria extracts (Saponins). By Mario Hernandez-Acosta Dissertation submitted to University of Arizona. 2009.

²³ Santacruz-Reyes R et al. Ammonia reduction in seawater by yucca schidigera extract: efficacy analysis and empirical modeling. *Aquaculture Research*. July 2010. 41(8): 1221-1228.

²⁴ Serrano AE. Effects of Quillaja saponins on growth, feed efficiency, digestive enzyme activities and metabolism of common carp (*Cyprinus carpio* L). *Aquaculture Nutrition* 2013 (19): 468-474

Distinguish Your Livestock Feed Products With These 5 Standout Natural Ingredients

The livestock feed industry is paying more and more attention to natural ingredients. According to Frost & Sullivan market analyst Christopher Shanahan, by 2019 the market for natural ingredients for livestock feed is climbing steadily with a CGAR of 5.1% and projected to reach \$17.28 billion.

Here are some exceptional ingredients with explanations on the unique ways they can contribute to producing standout livestock feed.

Which Ingredient Is Right For Your Customers' Operations

	Yucca SaponAID™	Quillaja FOAMEX™	Selenium SelenoExcell®	Milk Calcium COWCIUM®	Prebiotics Heli-Fos™
Cattle	X	X	X	X	X
Poultry	X	X	X	X	X
Pigs	X	X	X	X	X
Aquaculture	X	X	X		
Whitetail Deer			X	X	

Snapshot on Saponins

Saponins derived from Yucca and Quillaja have been demonstrated to support livestock immunity, digestion and overall productivity. Uniquely, these special compounds show particular promise in helping to eliminate a major headache of livestock operation managers – odor. These saponin-rich extracts can significantly reduce the ammonia content and methane gas production associated with livestock waste.

Yucca

A native to the Mexican desert country of Baja California, *Yucca schidigera* can grow 3 to 4 meters in height. Native Americans use it traditionally to make soap thanks to the beautiful suds it produces. Its foaming properties along with other health benefits have garnered the attention of the food and beverage industry and the supplement industry as well.

Animal nutrition researchers initially honed in on yucca because it reduced protozoa numbers in the rumen. Yucca's saponins destroy the cholesterol in protozoa cell membranes, killing the protozoa as a

result.²⁵ Because protozoa interfere with proper fermentation in the rumen, eliminating them can improve digestion and feed efficiency.²⁶

Researchers and livestock managers have been pleasantly surprised to discover this attack on protozoa yields some unforeseen benefits. By reducing ammonia-producing protozoa, Yucca reduces the amount of ammonia produced in livestock waste.^{27 28} Cutting down on ammonia reduces odor, making it easier for farmers to stay in the good stead of their neighbors. But the benefits of ammonia reduction go further. Thanks to this, Yucca extract supplementation can help with production and overall health for dairy cows, meat cattle, swine, sheep, poultry and shrimp.

- One study found feeding Yucca extract to sows before farrowing resulted in a significant decrease in stillborn piglets and pre-weaning mortality. Further examination revealed blood oxygen levels were much higher in the piglets from sows fed Yucca extract.²⁹
- Poultry farm research has shown by reducing ammonia, farmers achieve better egg production, broiler gain and feed efficiency.³⁰ A fact sheet produced by the Poultry Industry Council proposed Yucca supplementation may help reduce the problem of ascites.³¹
- Dairy herds have shown increased milk production of 6.8% with the addition of 125 ppm Yucca extract to their feed.³² Young calves in transport and steers have also shown increased weight gain thanks to saponins added to their feed.^{33 34}

It still has not been fully established how Yucca extract and other saponins affect the more complex microbe populations of ruminant guts in total.³⁵ In addition to its effect on protozoa, Yucca suppresses gram positive bacteria and some fungi. But some research indicates microbes supported by Yucca extract may be particularly helpful in maintaining healthy fermentation and feed efficiency for ruminants on high grain diets.³⁶

Yucca extract is not just for big animal operations. Pet owners too are starting to seek out this ingredient. When added to dog and cat food, Yucca reduced bad odor in their feces by up to 56% for

²⁵ Hristov, A. N., T. A. McAllister, F. H. Van Herk, K.-J. Cheng, C. J. Newbold, and P. R. Cheeke. 1999. Effect of Yucca schidigera on ruminal fermentation and nutrient digestion in heifers. *J. Anim. Sci.* 77:2554-2563

²⁶ Cheeke, PR. Saponins: Surprising benefits of desert plants. Linus Pauling Institute. 1998

²⁷ Wallace, R. J., L. Arthaud, and C. J. Newbold. 1994. Influence of Yucca schidigera extract on ruminal ammonia concentrations and ruminal microorganisms. *Appl. Environ. Microbiol.* 60:1762-1767.

²⁸ Wang, Y., T. A. McAllister, C. J. Newbold, L. M. Rode, P. R. Cheeke, and K.-J. Cheng. 1998. Effects of Yucca schidigera extract on fermentation and degradation of steroidal saponins in the rumen simulation technique (RUSITEC). *Anim. Feed Sci. Technol.* 74:143-153.

²⁹ Cheeke, PR. Actual and potential applications of Yucca schidigera and Quillaja saponaria saponins in human and animal nutrition. *J Anim Sci* 2000 (77): 1-10.

³⁰ Kutlu HR et al. Yucca schidigera extract: A natural feed additive affecting performance of broiler chicks.

³¹ Summers, John. Is a new approach needed in looking at the ascites problem? Factsheet #52. Poultry Industry Council. 1992

³² Valdez FR et al. Effect of steroidal saponins on ruminal fermentation and on production of lactating cows. *J. Dairy Sci.* 69, 1986: 1568-1575

³³ Mader TL et al. Effect of feeding sarsaponin in cattle and swine diets *J. Anim. Sci* 65:9-15. 1987

³⁴ Ward CF et al. Effects of SarStart DSC on performance and carcass characteristics of finishing beef steers fed dry-rolled or steam-flaked corn diets. Burnett Center Internet Progress Report No. 5, 2000.

³⁵ Cheeke 2000

³⁶ Cardozo PW et al. Screening for the effects of natural plant extracts at different pH on in vitro rumen microbial fermentation of a high-concentrate diet for beef cattle. *J Anim. Sci.* November 2005. 83(11): 2572-2579.

dogs and 49% for cats. The same researchers found that ammonia was reduced by as much as 81% in the litter of cats fed this saponin-rich extract.³⁷

SaponAID™ Essential Agro-Industrial Saponin Powder

Garuda's SaponAID™ Essential Agro-Industrial Saponin Powder is made from 100% *Yucca schidigera* stalks. The mature twigs of Yucca are sustainably harvested after 4-5 years. The woody material is dried into a fine powder which is then, in turn, used for animal feed. It is produced entirely by mechanical means, not by chemical extraction. Each batch is tested by third-party labs to ensure it is free of microbial pathogens and has at least 8% saponin content. We work closely with licensed native groups in Mexico to ensure the Yucca is the correct species and harvested in compliance with strict sustainability regulations. SaponAID™ Essential Agro-Industrial Saponin Powder has a guaranteed shelf life of 4 years.

Quillaja

Like Yucca, *Quillaja saponaria* is a great source of saponins. Yet, unlike Yucca, Quillaja contains triterpenoidal saponins – not steroidal saponins.

A native to the arid parts of Chile, Quillaja – also known as soapbark tree - has been used traditionally as a sudsy, detergent. Beverage manufacturers have taken advantage of its long-standing foaming properties and cosmetic manufacturers have used it as a preservative in shampoos and lipsticks.

Since its immune-stimulating properties were discovered in the 1930's, Quillaja extract has been used as an adjuvant in veterinarian vaccines. The purified fraction, known as Quil A, has shown particular effectiveness when used with anti-protozoa vaccines.³⁸

Quillaja offers benefits similar to Yucca's for livestock farmers. Its saponins reduce odor from ammonia and methane. It also has antimicrobial and antifungal properties that may help with livestock health.

Trials using Quillaja additives in aquaculture have been mixed. While some research showed Quillaja made no difference to fish weight gain and even may have injured fish intestines, other research has contradicted this finding. Research involving carp and tilapia aquaculture has shown it can contribute to an overall increase in weight gain and feed efficiency. One trial on carp found Quillaja supplementation at a concentration of 150 mg/kg resulted in 37.5-73.2% increase in average body weight over controls.³⁹

FOAMEX™

Garuda's FOAMEX™ feed-grade Quillaja extract is made by harvesting the entire tree. The wood and bark are then boiled in large tanks and the water extract is drawn off and concentrated using evaporation. FOAMEX™ is a dark brown, free-flowing powder. It is tested by third party labs for at least 15% saponin content. No preservatives are added and it has a guaranteed shelf-life of 2 years.

³⁷ McFarlane, J. Can we make a measurable difference in pet waste control? *Petfood Industry*, Nov/Dec, 1988

³⁸ Cheeke, 2000

³⁹ Serrano AE. Effects of Quillaja saponins on growth, feed efficiency, digestive enzyme activities and metabolism of common carp (*Cyprinus carpio* L). *Aquaculture Nutrition* 2013 (19): 468-474

Essential Selenium

USDA Agricultural Research Services soil scientist Gary S. Bañuelos point out "Selenium deficiency is a major problem for livestock or wildlife in at least 37 states and costs beef, dairy, and sheep producers an estimated \$545 million in losses every year."⁴⁰

Crucial for many areas of health, selenium is used in the construction of as many as 100 different proteins in the body. Adequate selenium levels have been linked to immune health in particular and good health overall. It's implicated in protecting humans and animals alike from myriad health issues.⁴¹

Selenium is essential for the production of the enzyme glutathione peroxidase, produced by the body to protect the health of cell membranes. Glutathione peroxidase acts as a powerful antioxidant in protecting lipids throughout the body from oxidation. Because of glutathione peroxidase's importance and selenium's key role in producing it, some scientists are suggesting selenium should be considered an essential nutrient.

Livestock derive selenium from forage and feed. However, when feed crops are grown on selenium-poor soils, their selenium content goes down. Commonly used sulfate- and phosphate-based fertilizers may also interfere with plants uptake of selenium.

For this reason more and more livestock farmers have turned to selenium supplementation. However, not all seleniums are created equal. Research has shown that the chelated forms – selenomethionine and selenocysteine – are much more bioavailable than selenium salts.

In addition to its role in glutathione peroxidase production, organic selenomethionine can be stored in muscle tissues ensuring more consistent selenium levels in the body. Inorganic selenium cannot be stored in the body this way. Also, while organic selenium works right alongside vitamin C in supporting animal health, vitamin C turns inorganic selenium into an inert metal that animals cannot use for nutrition.⁴²

Selenium yeast produces the bioavailable, chelated forms, making it increasingly the feed supplement of choice.

- Poultry farmers have found selenium improves reproduction at all levels – starting from semen quality to embryo growth and development.⁴³
- Selenium has been associated with lower drip rates and more tender beef, translating into higher quality and more efficient production.

⁴⁰ Kenaf and Canola – Selenium Slurpers. United States Department of Agriculture Agricultural Research. June 2000.

⁴¹ Daniells S. Selenium deficiency may increase risk of chronic disease: Study. Nutraingredients Mar 2011.

⁴² Sweetman J. Aquaculture turns eye on organic selenium. Feed Mix April, 2008. 16(1)

⁴³ Surai PF et al. Selenium in poultry breeder nutrition: an update. Animal Feed Science and Technology. 2014.

- Aquaculture operations are also seeing better fish health and growth with selenium supplementation.

On the consumer end, seafood, meats and dairy products from animals fed selenium have higher levels of selenium in them as well. For consumers who are increasingly concerned about getting enough selenium thanks to its role in cancer prevention, this may offer a market edge.

Some preliminary research also indicates selenium may interfere with mercury's toxicity. With consumer concerns about mercury contamination of fish, this may prove to be especially helpful in maintaining seafood marketability.⁴⁴

SelenoExcell® High Selenium Yeast

Garuda's SelenoExcell® High Selenium Yeast is the form of selenium used in the Nutritional Prevention of Cancer Trial which demonstrated selenium's role in preventing cancer and cancer mortality. SelenoExcell® is a high potency (1200 mcg/g), 100% organically-bound selenium yeast product. It replicates the mineral conversion process used by plants to produce bioavailable organic forms of selenium. This natural form of selenium provides a full composition of seleno compounds including amino acid complex and lipids.

Each batch of SelenoExcell® is independently tested to ensure it has 1,150-1,260 ppm selenium, minimizing batch to batch variations. It is also tested for heavy metals and microbial contamination.

Milk Calcium For Bigger Trophies

Calcium keeps the heart beating, builds bones, strengthens eggshells and supports healthy reproduction and milk production. Traditionally, animals have derived calcium from feed. But forage and grain grown on calcium-poor soils end up containing low amounts of this important mineral. Also, certain plants like alfalfa contain calcium in the form of calcium oxalate which is very poorly absorbed.

Some farmers have added inorganic calcium to their feeding plan to help counter this problem. However, inorganic calcium is not as bioavailable as dairy-sourced calcium. Additionally, as the livestock industry has changed from confinement operations to more grass-fed, free-range production, assessing mineral intake and maintaining proper ratios of calcium to other minerals has become more difficult.

For this reason milk calcium offers an excellent option. Made from the dry whey of milk, milk calcium contains calcium and phosphorus in the ideal ratio of 2:1.

White tail deer ranchers have shown particular interest in the use of milk calcium for promoting healthy antler growth in their bucks. Every year bucks grow a new set of antlers that are shed in January. While

⁴⁴ Dietary selenium protects against selected signs of aging and methylmercury exposure. *Neurotoxicology*, 2010;31(2):169-79

initially the growing antlers are made up of mostly protein, this ratio shifts as the antlers harden. Calcium and phosphorus comprise 30-35% of the mature antler weight.

Preliminary research in Pennsylvania indicates a diet of .7% calcium and .6% phosphorus is required for healthy antler growth. Research out of Texas indicates it may be even less.⁴⁵ Nonetheless, researchers agree, calcium and phosphorus play a key role in the secondary development of deer antler and overall deer health.

As researchers at Mississippi State University's deer lab explain, when antler growth shifts from the initial protein phase to mineralization, bucks mobilize minerals from their bones to supply the calcium and phosphorus for antler growth. Based on this understanding, deer management experts advise that optimal mineral nutrition can help these animals achieve better all-around growth, health and consequently better antler growth.⁴⁶ Research out of Mississippi State University has shown deer foraging on phosphorus rich soils have bigger body size as well.⁴⁷

Garuda's COWCIUM® Natural Milk Calcium 24

Garuda's COWCIUM® Natural Milk Calcium 24 is a fine, white, neutral -tasting powder produced entirely from the dairy whey produced by U.S. dairy herds. With third party testing, we ensure it has a minimum of 24% calcium. It also contains 10% phosphorus. Third party labs also test it to ensure safe heavy metal and microbial limits.

Prebiotics For Productivity

With the European Union's ban on the use of antibiotics and hormones and the growing public interest in naturally-raised meats, eggs and dairy products, researchers and farmers have been earnestly looking for alternatives to help them maintain feed efficiency and animal health.

And prebiotics are capturing much of the limelight.

Prebiotics are fibrous materials – non-digestible fructooligosaccharides - found in high concentration in plants like chicory, agave and Jerusalem artichokes. These fibers are the favorite food of the probiotic bacteria found in both guts of ruminants and the hindgut of non-ruminants. Probiotic bacteria make the gut inhospitable to pathogenic bacteria, fungi and protozoa. They also seem to play a role in supporting

⁴⁵ Demarais S. Managing for antler production. Research Advances. Forest & Wildlife Research Center. August 2002 7(1).

⁴⁶ Antlers. Forest & Wildlife Research Center. Mississippi State University Extension website. Viewed 3/1/14 at <http://www.msudeer.com/nutrigen.asp>

⁴⁷ Murphy B. Minerals for whitetails. Quality Deer Management Association website. Viewed 3/1/14 at <http://www.qdma.com/articles/minerals-for-whitetails>

overall immune health in animals.⁴⁸ By sustaining a healthy bacterial culture in the gut, these bacteria bring a number of benefits.

Prebiotics in non-ruminants like poultry, swine and rabbits

- improve gut health;
- improve immune health;
- increased calcium absorption;
- reduced ammonia emissions; and
- improve product quality.

In ruminants like cattle and sheep, prebiotics help

- reduce rumen ammonia nitrogen;
- reduce methane production;
- increase protein synthesis; and
- increase live weight gain in calves.⁴⁹

Jerusalem artichokes (*Helianthus tuberosus*), a traditional feed for pigs, are a particularly good source of the prebiotic inulin. Researchers have also demonstrated they can help reduce the need of antibiotics in pigs.⁵⁰ They also have been shown to reduce the odor from pig manure.⁵¹ Pig farmers have found Jerusalem artichokes do a particularly good job as feed during the late fattening stage and for pregnant sows.⁵²

Poultry farmers have also had good success with dried Jerusalem artichoke powder added to feed. It seemed to improve immune health, feed efficiency, growth and with no ill effects on egg production. According to a 2003 review of research, .4% supplementation of the prebiotic FOS increased the levels of helpful Lactobacilli and Bifidobacteria in the intestines of chickens and significantly reduced the levels of pathogenic Salmonella and E. coli bacteria.^{53 54}

Heli-Fos™ Jerusalem Artichoke Flour

Garuda's Heli-Fos™ Jerusalem Artichoke Flour is made by washing the tubers carefully. The clean tubers are then sliced, dried and milled into a powder. With its mildly sweet, slightly malty flavor it makes a great addition to milk replacer at a critical time when young animals are developing their gut microbial

⁴⁸ Mavromichalis I. Using inulin in pig and poultry feeds. *Feed Management*. March – April, 2013. 64(2).

⁴⁹ Samanta AK et al. Prebiotic inulin: Useful dietary adjuncts to manipulate the livestock gut microflora. *Braz J Microbiol*. 2013. 44(1): 1-14.

⁵⁰ Blair R. Nutrition and feeding of organic pigs. Cabi Series, CABI ,2007. Wallingford, UK

⁵¹ Farnworth et al. Adding Jerusalem artichoke (*Helianthus tuberosus* L.) to weanling pig diets and the effect on manure composition and characteristics. *Anim. Feed Sci. Technol.*, 55(1-2): 153-160

⁵² Iannone, A et al. Jerusalem artichokes, ideal for pigs at pasture. *Rivista di Suinicoltura*, 2003. 44(12): 50-59

⁵³ Kleessen, B et al Jerusalem artichokes stimulate growth of broiler chickens and protect them against cecal endotoxins and potential pathogens. *J. Food. Protec.*, 66 (11): 2171-2175

⁵⁴ Yildiz, G et al. The effect of dietary Jerusalem artichoke (*Helianthus tuberosus* L.) on performance, egg quality characteristics and egg cholesterol content in laying hens. *Czech J. Anim. Sci.*, 51(8): 349-354.

population. Each batch is tested for safe microbial limits by third-party labs and has a guaranteed 3-year shelf life. Organic Heli-Fos™ Jerusalem Artichoke Flour is certified organic by Oregon Tilth.

Interested in more details on these great livestock feed ingredients?

Contact our sales staff at +1 (559) 594-4380 or feedingredients@garudaint.com

You can also visit our website for more information at www.garudaint.com.

We look forward to helping you secure the ingredients that can make your products stand out.