BVS POULTRY Talk

Best Veterinary Solutions, Inc.

Fall 2016

www.bestvetsolutions.com

Willmar, MN
325 Lakeland Drive NE • P.O. Box 266
Willmar, MN 56201
320-235-8611 or 1-800-533-1899
Fax 320-235-8629

Ellsworth, IA
1716 Detroit
Ellsworth, IA 50075
888-378-4045
Fax 515-836-4464

Washington, IN
1854 Waller Drive
Washington, IN 47501
877-254-3410
Fax 812-254-2337

Mechanicsburg, PA
1 Brenneman Circle
Mechanicsburg PA 17050
844-561-4918

Dagsboro, DE
30124 Country Gardens Blvd.
Suite G2
Dagsboro, DE 19939
877-732-3894

CONTENTS

www.bestvetsolutions.com

Copper(II): An ancient remedy for gut pathogen control in poultry

Rosemary A. Marusak, PhD, DVM, MSpVM, dACPV
Staff Veterinarian and Director of Technical Services Laboratory

The biocidal properties of copper were known even in antiquity.[1] Prior to the discovery of modern antibiotics in the 1920s, copper ions - either alone or bound to organic ligands - were used as anti-bacterials as well as anti-fungals and anti-virals. Anti-bacterials, anti-fungals and anti-virals are used today in wood preservation, preparation of Bordeaux and Burgandy mixtures, reservoir and swimming pool treatment, and in hospitals to prevent nosocomial infections. With new antibiotic-free poultry production systems and the movement towards reduction of antibiotic use in animal agriculture in general, copper has re-emerged as a "new, ancient remedy" for controlling bacterial pathogens in the poultry gut.

One of the great advantages of modern antibiotics is that we have a very good understanding of how and why they work and importantly, why they don't. We have been taught how to use them judiciously to avoid bacterial resistance. One problem with many nutraceuticals now on the market is the lack of regulation on product composition and further, an incomplete understanding of their mechanisms of action. We are forced to try different products for treatment of various conditions and must

continued on page 3

EDITORIAL COMMENT:

You Can't Build a Healthy Intestine Out of Brix

Robert L. Owen, V.M.D., Ph.D.
Director of Technical Services

The title for this article was kindly provided by the newest member of the BVS team, John Menges. While still in his former role as a live production manager, John was doing what we have been asking people to do with anyone coming in to sell you a non-FDA approved "all natural product" – ASK QUESTIONS.

So the questions he asked were: what are the active ingredients in your yucca

continued on page 2

product and what levels of active do you guarantee. The response was we have the highest Brix in the industry. The conversation continued – Question: What are the saponin levels? Response: What are they? And to use the famous signature line from comic Bill Engvall - "Here's your sign".

Brix is a term used to define the sugar content in an aqueous solution. One degree Brix is 1 gram of sucrose in 100 grams of solution and represents the strength of the solution as percentage by mass (https://en.wikipedia.org/wiki/Brix). In agronomy the brix level is the percentage of solids present in the juice of a plant. These solids are mostly made up of sugar and minerals. Just squeeze the item till you get a drop of juice, then use a Refractometer to test its brix level (http://www.healthy-vegetable-gardening.com/brix-level.html). Brix is a very useful measurement if you are planning to produce beer or wine from your Yucca product but is not a reflection of active ingredients in these products. In order to improve the Brix value all one has to do is add some additional sugar to the liquid. Brix is a term used only with liquid products.

In "the good ole days" when products were subject to governmental approval the purity and potency of the product was verified. When a veterinarian reached for a bottle of penicillin, he or she knew by looking at the label that the product contained 100 mg of penicillin per ml of solution. The same was true for feed additives- a bag of Aureomycin® contained 100 grams of chlortetracycline per pound and this could be sent off to a laboratory and confirmed. The active ingredient in products derived from Yucca is saponin. Is it not reasonable to expect when we reach for a bottle or bag of a Yucca derived product that we should be able to read the saponin content of the product we are using?

In this new "natural" world in which we find ourselves living not only do we not have assurances of how much active ingredient is in the product we have no assurances that any active ingredient at all is in the product. This author recently obtained two blended yucca products taken from two different geographic locations in the US and tested them for saponin levels. The results were consistent – no detectable saponin levels were found in either product.

One has to be continually amazed at the veritable explosion of products being sold as good for the health of the animals but lacking even the most rudimentary information about what is in them or how they work. I truly believe that we are reverting back to the wild - west days where everyone was toting a six gun and shooting each other; and snake oil salesmen were traveling around in wagons wearing derbies and silk vests selling the latest magic elixir of life.

For a veterinarian, the importance of knowing what we are using to treat the animals we are trying to heal was driven home at the recently completed AAAP meeting in San Antonio. After finishing a talk on this very topic, I was approached by Dr. Joel Cline of Wayne Farms. Joel asked me if I had ever read the "Principles of Veterinary Medical Ethics of the AVMA" published on the AVMA website. I ashamedly had to admit I had not. Dr. Cline had because he was studying for a state board exam and directed me to Principle 1 Subpart C:

1. A veterinarian shall be influenced only by the welfare of the patient, the needs of the client, the safety of the public, and the need to uphold the public trust vested in the veterinary profession; and shall avoid conflict of interest or the appearance thereof.

    c. Veterinarians shall not promote, sell, prescribe, dispense, or use secret remedies or any other product for which they do not know the ingredients.

Please understand that you can't build a healthy intestine out of Brix. Learn to ask the right questions. Where are the ingredients produced? What is the active ingredient? How is it extracted? How is it tested for purity and potency? What is the guaranteed analysis? What dosage should be used and for how long? What adverse reactions might be seen? What is the withdrawal time for meat and/or eggs?

These are the same questions that companies had to answer for the FDA before this "natural ingredient" mania swept poultry production. Because most of the so called natural products are not FDA approved these questions are no longer being addressed. That does not mean that the questions should not be asked. It just means that the responsibility has shifted from FDA to the consumer. It is time we start asking because we should be informed consumers; but more importantly it's about the animals. Regardless of the outside pressures/influences being exerted they deserve the very best that veterinary science has to offer each and every day of their lives.

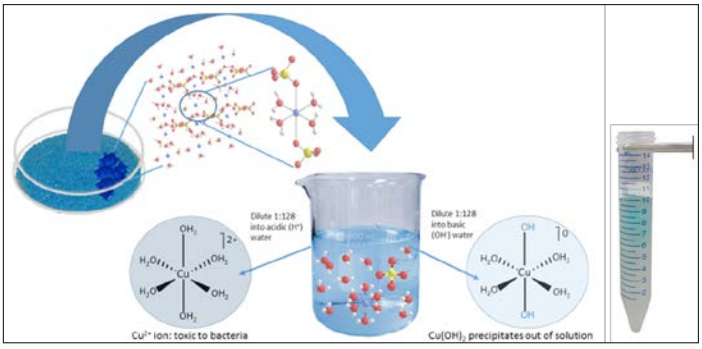
accept that "sometimes they work and sometimes they don't." We at BVS are trying to elucidate the underlying mechanisms of these products so farms can use these with maximum benefit and success.

Because of the long and extensive use of copper and its organic complexes, the biocidal mechanism of copper has received more research attention than most other agents. This article begins a series on copper use in poultry production. In this installment we introduce to you basic copper chemistry and copper's antibacterial mechanism of action so that you can develop a program with this biocide in the safest and most effective way on the farm.

Copper(2+), the form toxic to bacteria, is insoluble at higher pHs

Copper exists in three forms: metallic copper (Cu^0) and its two ions, copper(I) (Cu^+) and copper(II) (Cu^{2+}). Copper(II), in the form of copper(II) sulfate ($CuSO_4$), is what we use to treat our birds for enteric issues. The structure of $CuSO_4$ and its properties when dissolved in water are shown in **Figure 1**. If an aqueous solution of $CuSO_4$ is acidic, the copper will stay in solution as the hydrated 2+ ion (Cu^{2+}). However, if the solution is basic (>pH 7), less soluble and insoluble copper hydroxides, $Cu(OH)^+$ and $Cu(OH)_2$, will form and begin to precipitate. In fact, the pH range in which copper hydroxides start precipitating is 4-6.[2] Copper hydroxide may eventually dehydrate and turn black with formation of the insoluble copper(II) oxide (CuO). These insoluble Cu^{2+} forms (species) will be less available to the birds.

Figure 1. Aqueous solution chemistry of crystalline $CuSO_4$.



Solid state $CuSO_4$ crystal lattice and hydrated $CuSO_4$ structure adapted from ball & stick models by Ben Mills. Source: https://commons.wikimedia.org/wiki/File:Copper(II)-sulfate-pentahydrate-Cu1-coord-xtal-2007-CM-3D-balls.png (original crystal structure: *American Mineralogist* (2007) **92**, 532–545)

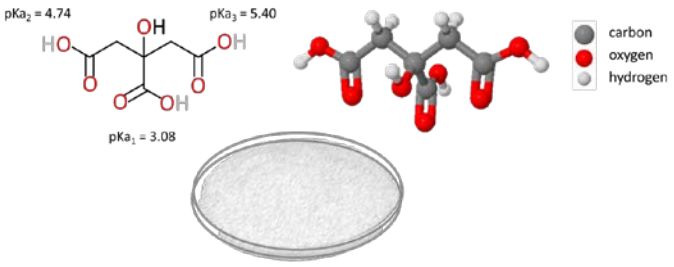
Citric acid is a low molecular weight organic acid that binds and solubilizes copper(II) at high pH

Citric acid (cta), shown in **Figure 2**, is a weak organic acid that lowers pH and acts as a buffering agent for the copper solution (a buffer solution is one that resists change in pH when small quantities of acid or base are added). The three buffering sites on cta (dissociable protons, H^+) are in gray in **Figure 2** and the pH of maximum buffering capacity (pKa) for each is noted.[3] Organic acids, such as cta, are in and of themselves, beneficial to the health of the bird by reducing harmful bacteria in the gastrointestinal tract, decreasing digesta pH, and promoting trophic effects on the gastrointestinal mucosa among others.[4] An added benefit is cta's ability to bind and solubilize Cu^{2+} at high pH. By combining cta with $CuSO_4$ in a 1:1 mole ratio, and depending on pH, either 2 or 3 of the carboxylic acid ($(^-O)C=O$) oxygens on cta will deprotonate ($-H^+$) and displace water molecules originally bound to the Cu^{2+} metal center. This binding interaction is shown in **Figure 3** for both a dimer (2 coppers), which exists at higher pH's, and the monomer (1 copper) that exists at lower pH in equilibrium with free, hydrated Cu^{2+}.[5] We term this type of binding "chelation" (chelate literally meaning "claw") since the cta "wraps around" and encapsulates the Cu^{2+} ion. Along with solubilizing the copper at higher pH, the addition of cta may also aid in the palatability of the drinking solution for the birds.

Preparing a copper-citric acid solution

In light of the chemistry described above, it is best to prepare your Cu^{2+}-cta solution by first dissolving the citric acid into a minimum amount of water and then adding the copper sulfate to this. Additional water may then be added to bring up to the desired stock volume. The solution should be stirred for at least ½ h to allow the components to equilibrate.

Figure 2. The fully protonated citric acid molecule.



In mammals and birds, Cu^{2+} is absorbed primarily in the upper small intestine and to some extent in the stomach.[6] Small organic ligands, such as cta, are known to increase the bioavailability of copper and enhance its absorption.[6-7] However, in our case, we prefer that minimal host absorption of Cu^{2+} occurs to allow maximum delivery to harmful bacteria within the intestinal tract. It is currently not known what form of Cu^{2+} is delivered to the bacteria, but based on the speciation in **Figure 3** and pH of the avian gastrointestinal tract, **Figure 4**, a mixture of Cu^{2+} species is most likely found. The most optimal conditions for delivery of copper to the birds for maximal bacterial kill with minimal side effects have yet to be defined.

continued on page 5

Solutions for Organic Production

Acidifiers:

BVS Citric Acid

BVS Liquid Citric Acid

BVS Acidified Copper Sulfate

Dry Cider Vinegar

Essential Oils:

Biosupreme® L

Biosupreme® Organic Feed Grade

EnviroSupreme Green

Orego-Stim™

Cleaners/Disinfectants:

Keno™ X5

Keno™san

Pro Oxine®

Gil-O-Fact II

Supportive Care:

AviCare™

XPC™ Green

CitrisStim®

Hilyses™

Aspirin (Liquid or Dry)

Mucusol®

BVS Vitamin D3 Liquid

BVS Poult Start

BVS Vitamin EKA + D3

BVS Sol-U-K

BVS Solulytes Natural

Insecticides:

Essentria™ All Purpose Consentrate

Poultry Shield FG Sulfer

Yellowjackets Dust Sulfer

Litter Ammendments:

Klasp™

Please contact your BVS Salesman for more information on the products we offer for organic production

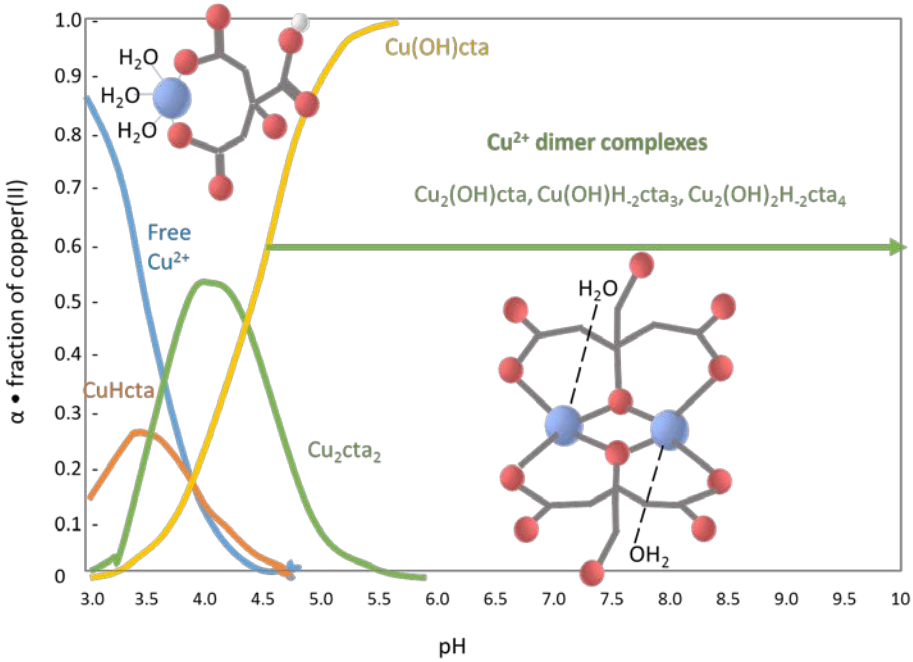
BVS

Best Veterinary Solutions

*Not all products mentioned above are OMRI Listed. Approval for use in organic production is subject to approval from company's/grower's organic certifier.

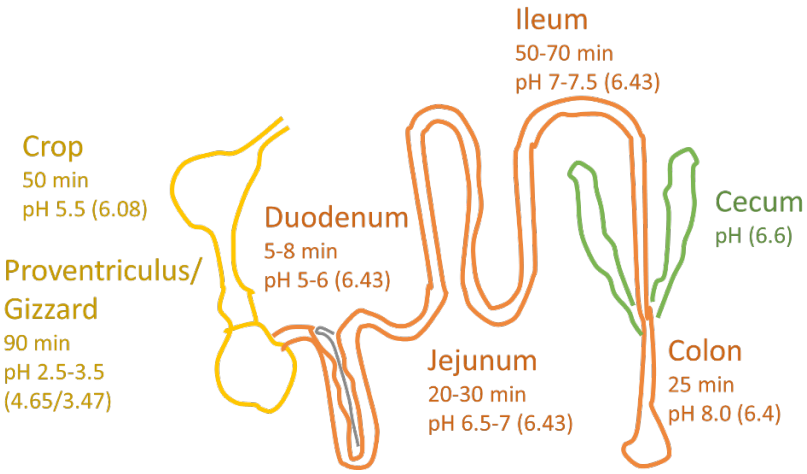
ADM · Kemira · Agroin Baja Agro International · Bio-Cide International, Inc. · Diamond V · Animal Science Products Incorporated · CID Lines innovative hygiene solutions · Lohmann Animal Health · envincio

Figure 3. Species Distribution of Cu-cta over the pH range 3.0-10. Copper atoms are blue.



Copper-cta species distribution diagram at pH 3-6 adapted from ref. 5a. Dimer complexes at high pH are from ref. 5b and c.

Figure 4. The gastrointestinal tract and measured transit times and pH.



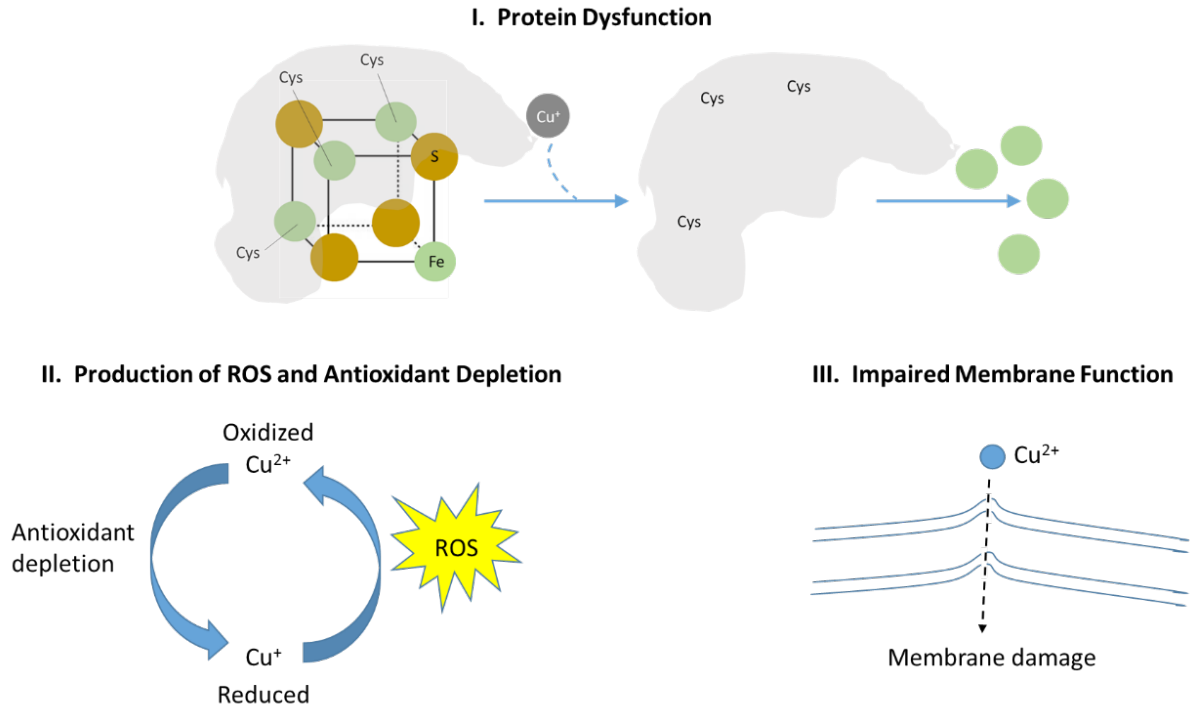
Poultry gastrointestinal tract and general poultry pH values from http://www.thepoultrysite.com/articles/978/maintaining-gut-integrity/ and pH values for 70 d old broilers noted in parentheses are from ref. 8.

Copper Speciation is important for bactericidal activity

While copper is relatively safe for mammals and birds, bacteria are much more sensitive to toxicity.[1] Several mechanisms have been put forth to explain the bactericidal properties of Cu^{2+}. These are shown schematically in **Figure 5** and include: 1) chemical reactions with internal proteins integral to bacterial function and survival (e.g. Cu^{+} destabilization of Fe-S clusters in bacterial proteins); 2) participation in oxidation-reduction chemistry, resulting in free radicals that damage external/internal proteins and/or bacterial nucleic acids; 3) direct binding to proteins on the bacterial surface membrane, altering protein shape and compromising bacterial membrane permeability and function.[1c] The mechanism of toxic action is thought to depend on the bacterium and in fact toxicity may involve multiple mechanisms.

continued on page 6

Figure 5. Mechanisms of action for bacterial copper toxicity (Modified from ref. 1c)



ROS = reactive oxygen species (i.e. oxygen radicals: hydroxyl radical •OH, peroxyl radical •OOH)

Cu^{2+} may act on the bacterium internally (mechanisms I and II) or externally (mechanisms II and III). For internal mechanisms, uptake of Cu^{2+} by the bacterium most likely involves the use of known Cu^{2+} transporters. Alternatively, but less likely, Cu^{2+} may be co-transported with cta via the intact Cu^{2+}-cta complex. Regardless of the form by which Cu^{2+} is delivered to and/or taken up by the intestinal bacteria (as "free" (hydrated) Cu^{2+}, Cu^{2+}-cta (monomer), or Cu^{2+}_2-cta_2 (dimer)), it is most probable that toxicity involves release of the Cu^{2+} from the cta ligand to external or internal bacterial biomolecules. Copper bactericidal properties are in fact mitigated by cta.[10-11] Interestingly, these studies have all been carried out at relatively high pH (≥6) where the more stable and more substitutionally inert Cu^{2+} dimer complexes are favored. Low kill rates in the presence of cta at higher pH, therefore, may reflect a slower release of Cu^{2+} to the bacterium. It is expected that form (or species) of Cu^{2+} that is delivered to the targeted site will influence the efficacy of the treatment.[10, 12]

Follow-up copper treatment with a probiotic

Copper appears to be relatively indiscriminant with respect to its bacterial targets. It has been shown that copper will rapidly kill good bacteria in the gut, such as *Lactobacillus sp.* as well as pathogenic bacteria. It is important, therefore, to repopulate the birds' gut with good bacteria from a probiotic after each copper use.

Bacteria can become resistant to copper

As might be expected, some bacteria including *E. coli*, *Klebsiella sp.*, and *Pseudomonas sp.*, have evolved mechanisms for copper resistance. Bacterial chromosomal and plasmid copper-resistance systems promote reduced copper transport, increased copper efflux, and increased copper complexation, to protect bacteria from toxic copper overload. [1,13] However, the multiple pathways by which Cu^{2+} can kill bacteria, along with other novel host immune-mediated copper arsenals, present a great challenge for pathogenic bacteria, and resistance build-up is far less efficient and slower than that of the "traditional" bio-organic molecular antibiotic. We must still avoid promoting unnecessary Cu^{2+}- environmental stressors that lead to copper-resistant strains nonetheless. Already, the copper-resistant *Cupriavidus metallidurans*, a non-pathogenic bacterium that may be capable of transferring copper resistance to other bacteria,[14] has been isolated from poultry waterline systems where copper treatment is heavily used. Judicious use of copper for treatment of intestinal disease is therefore warranted.

In summary, Cu^{2+} solutions are very effective bactericidal agents and are being used more regularly to treat enteric issues in poultry. With regard to cta and other copper binding ligands, the nature of the copper species delivered to the bacterium appears to be important for effective and efficient bacterial kill. The first step is to ensure an appropriate Cu^{2+} solution is prepared for bioavailability and transport. More work is needed to understand the copper species ultimately reaching the bacteria in the bird's gut, but the microenvironment (pH, concentration, presence of other copper-binding moieties) is important. Because Cu^{2+} kills indiscriminately, it is important to follow-up treatment with a probiotic. Judicious use of copper and further understanding of its biochemistry and antibacterial action in our birds will improve the effectiveness of this important bactericidal remedy.

Glossary of Terms

Bactericidal – a substance that is destructive to bacteria
Bioavailabilty - a measurement of the rate and extent to which a drug reaches at the site of action
Biocide/biocidal - a substance that is destructive to many different organisms
Buffering agent/buffer – a chemical used to prevent a rapid change in pH when acids or bases are added to the solution
Carboxylic acid – an organic acid containing a carboxyl group (HO-C=O) Examples are citric acid and acetic acid (vinegar). These are weak acids that can be used as buffering agents or metal ion (copper(II)) binders.
Chelation – binding of a metal ion by an organic compound (ligand) that uses two or more attaching atoms
Chromosome(al) – the part of the cell (DNA-containing structures) that contains the genes that control how an organism grows and what it becomes
Deprotonate – to remove a positively charged hydrogen ion (H^+)
Digesta – something undergoing digestion (e.g. food in stomach)
Dimer – a molecule composed of two identical, simpler molecules (monomers)
Dissociable protons – positively charged hydrogen atoms (H^+) that are "held loosely" and readily removed by a basic substance from the atom/chemical to which they are bound
Equilibrium - the point at which the concentrations of reactants and products do not change with time
Fe-S Clusters (iron-sulfur clusters) - ensembles of iron and sulfide centers found in proteins that carry out chemical reactions
Hydrate(d) – surrounded by water molecules
Hydroxide – a diatomic (2 atoms) molecule made of one oxygen atom (O) and one hydrogen (H) atom and carries a negative charge (-). Written: OH^- and is obtained when a proton (H^+) is removed from a water molecule (H-O-H or H_2O) by a basic substance (e.g. ammonia, sodium hydroxide, etc.)
Ion - an atom or molecule with a net electric charge due to the loss or gain of one or more electrons
Ligand - a complexing group that stabilizes the central atom and determines it reactivity
Mucosa - a mucous membrane that lines various cavities in the body (e.g. inner intestine)
Nosocomial – (infections) acquired in the hospital
Nutraceutical - derived from "Nutrition" and "Pharmaceutical", a food-stuff containing health-giving additives and having medicinal benefit -may be used in marketing but has no regulatory definition
Organic Complex – metal (e.g. copper) bound to a molecule containing carbon atoms (e.g. cta)
Oxidation-Reduction – the removal and gaining of electrons, respectively
Plasmid - a linear or circular piece of DNA that is capable of replicating independently of the chromosomal DNA
Precipitate - insoluble solid that emerges from a liquid solution
Radical - an atom, molecule, or ion that has unpaired electrons (and is very unstable and reactive)
Species - A set of atoms, molecules, ions, or other chemical entities (e.g. a copper complex) that possess the same distinct characteristics with respect to a chemical process or measurement. In this article, refers to the particular copper form being delivered to the bacterium. **Speciation** refers to the distribution of the different copper complexes that exist at different pH
Substitutionally inert (inert to substitution) – not reactive (or very slow to react) with respect to the release of the metal center from the organic ligand
Transporter – a transmembrane protein that moves ions/molecules across a (bacterial) plasma membrane
Trophic Effect – having a nutritive influence on cellular activity

References

1. a) Borkow, G and Gabba, J "Copper, An Ancient Remedy Returning to Fight Microbial, Fungal and Viral Infection" Current Chemical Biology, **2009**, *3*, 272-278; b) Borkow, G and Gabba, J "Copper as a Biocidal Tool" Current Medicinal Chemistry, **2005**, *12*, 2163=2175.; c) Lemire, JA, Harrison, JJ and Turner, RJ "Antimicrobial activity of metals: mechanisms, molecular targets and applications" Nature Reviews | Microbiology, **2013**, *11* 371- 384.
2. Walton,HF. "Principles and Methods of Chemical Analysis" Prentice Hall: New York, 1952.
3. Table of Acids with K_a and pK_a Values. Source (last accessed 09Sep2016): http://clas.sa.ucsb.edu/staff/Resource%20Folder/Chem109ABC/Acid,%20Base%20Strength/Table%20of%20Acids%20w%20Kas%20and%20pKas.pdf
4. Dibner, J. J. and Butti, P." Use of Organic Acids as a Model to Study the Impact of Gut Microflora on Nutrition and Metabolism" J. Appl. Poult. Res. **2002**, *11*, 453-463.
5. a) Field, TB., McCourt, JL, McByrd, WAE, "Composition and Stability of Iron and Copper Citrate Complexes in Aqueous Solution" Can. J. Chem. **1974,** *52*, 3119-3127. b) Hamada, YZ, Cox, R, Hamada, H "Cu2+-Citrate Dimer Complexes in Aqueous Solutions" J Basic & Appl Sci, **2015**, *11*, 583-589. c) Rajan K.S., Martell A.E., "Polymeric copper (II) complexes of hydroxy acids" J. Inorg and Nucl Chem. **1967**, *29*, 463-471.
6. Linder, MC in "Biochemistry of Copper", Springer Publ.: New York, 1991.
7. Ao ,T J. L. Pierce , R. Power , A. J. Pescatore , A. H. Cantor , K. A. Dawson , and M. J. Ford "Effects of feeding different forms of zinc and copper on the performance and tissue mineral content of chicks" Poultry Science **2009**, *88*, 2171–2175 and refs therein
8. Mabelebele, M. Alabi, O.J. Norris, N.D. Ginindza, MM. "Comparison of Gastrointestinal Tracts and pH Values of Digestive Organs of Ross 308 Broilers and Indigenous Venda Chickens Fed the Same Diet" Asian J. of Animal and Veterinary Advances, **2014**, *9*, 71-76.
10. Menkissoglu, O. Lindow, SE, "Relationship of Free Ion Copper to Bacteria in Solutions of Organic Compounds" Phytopathology **1991**, 1258-1263.
11. Joshi-Tope, G. Francis, A.J "Mechanisms of Biodegradation of Metal-Citrate Complexes by *Pseudomonas* fluorescens" J. Bacteriol., **1995**, 1989–1993.
12. Kiss, T. Odani, A "Demonstration of the Importance of Metal Ion Speciation in Bioactive System" Bull. Chem. Soc. Jpn. **2007** *80*, 1691–1702.
13. Cervantes, C. Gutierrez-Corona, F. "Copper resistance mechanisms in bacteria and fungi" FEMS Microbiology Reviews **1994,** *14* 121-138.
14. Van Houdt, R, Monchy, S Leys, N Mergeay, M "New mobile genetic elements in Cupriavidus metallidurans CH34, their possible roles and occurrence in other bacteria" Antonie van Leeuwenhoek, **2009**, *96*, 205–226.

Effect of Vaccine Application on the Litter on Oocyst Cycling in Broilers and Turkeys

Robert L. Owen, Hannah Menges

In a conversation shortly after the 2016 IPE, Dr. John McCarty of Merial Animal Health related his experiences with the application of HatchPak™ sprayed in the hatchery along with spraying an additional dose of vaccine in the environment at chick placement on the reduction in prevalence of necrotic enteritis in broilers. In order to learn more about what this may be doing to alter the cycling patterns of coccidiosis in vaccinated birds a series of studies were conducted at the BVS Science and Technology Center using both turkeys and broilers.

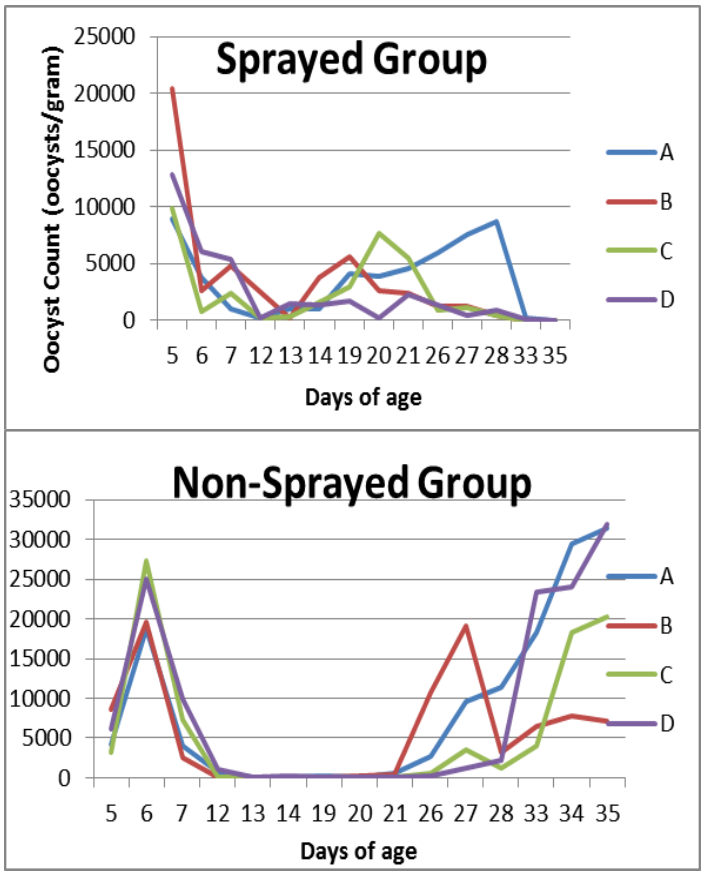
Materials and Methods:

Turkeys: Two separate trials were conducted to investigate the effect of an oregano containing feed additive on cycling of cocci in turkeys vaccinated with a commercial coccidiosis vaccine. Both trials were identical with 160 poults being obtained from a local hatchery. Upon arrival at the Technology Center each bird was individually gavaged with a 5X dose of vaccine and placed in groups of 10 in cages on new pine shavings. In the first trial no additional vaccine was sprayed on the litter and in the second trial a 5X dose of vaccine was sprayed in each pen using a small pump-up sprayer. The complete environment in which the birds were placed was sprayed with vaccine. There were 16 pens of birds including one group of 4 pens with no feed additive and 3 additional groups of 4 pens each with a different oregano containing feed additive. Fecal samples were collected from all groups on days 5,6,7; 12,13,14; 19,20,21; 26,27,28; 33,34,35. Oocyst counting was performed on these samples using McMaster counting chambers as per the standard operating procedure for the Technology Center. Feed and water were provided ad libitum throughout the trial.

Broilers Day-of-age broiler chickens were obtained from a local hatchery. At the hatchery the birds were spray vaccinated with a 1X dose of a commercial broiler coccidiosis vaccine. Pens at the Technology Center were randomly divided into 4 groups of 4 pens per group. The control pen was sprayed with untreated tap water. Group 2 pens were sprayed with tap water containing 1X dose of the same commercial vaccine, Group 3 pens with 5X dose and Group 4 pens with 10x dose. Fecal samples were collected from all groups on days 6,7,8; 13,14,15; 20,21,22; and 27,28,29. Oocyst counting was conducted the same as for the turkey trial. Feed and water were provided ad libitum throughout the trial.

Results:

Turkeys The individual daily counts for each group on both the sprayed and non-sprayed trials are shown in graph 1.

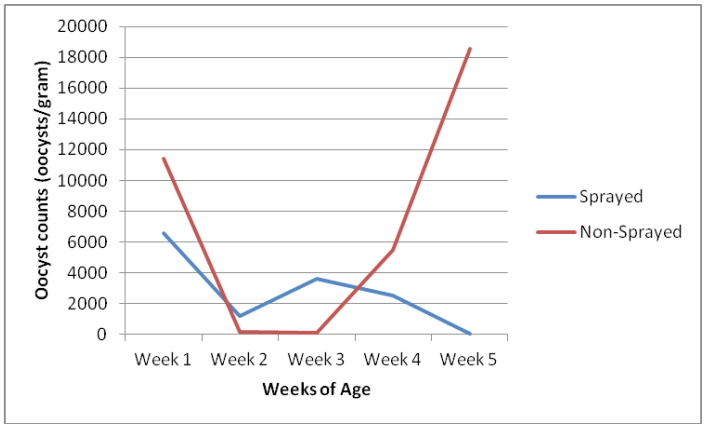


Graph 1: Plots of individual oocyst counts for all groups in both trials.

continued on page 9

Effect of Vaccine Application on the Litter on Oocyst Cycling *, continued from page 8*

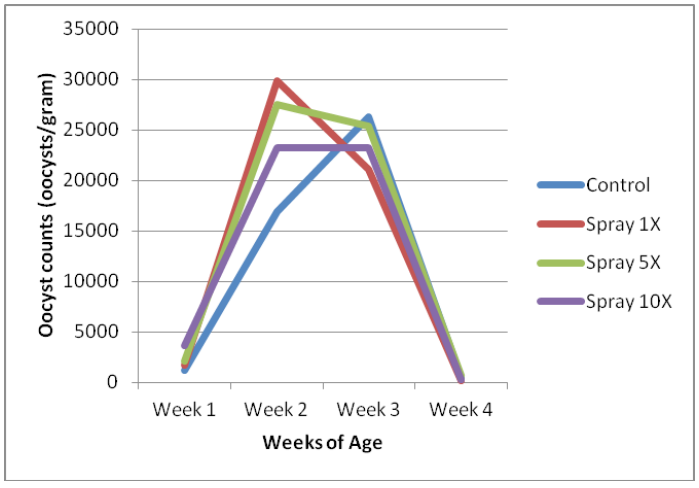
Since there was not significant difference in counts between groups, the data for all groups in each trial was pooled into sprayed and non-sprayed groups. The daily data was further pooled into weekly data and is shown in Graph 2.



Graph 2: Plots of oocyst counts for each week of the trials

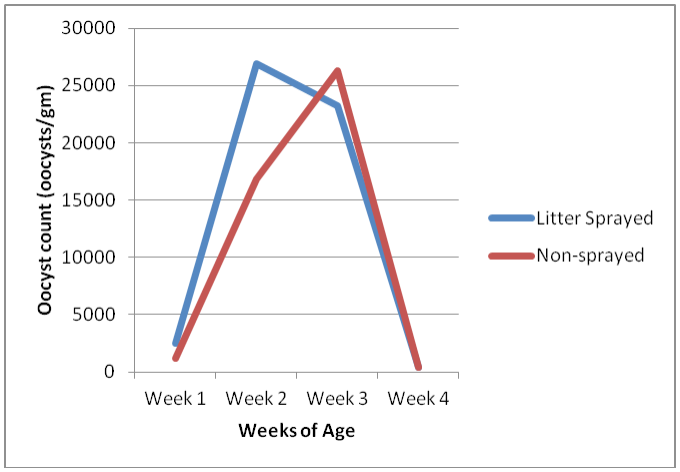
This graph demonstrates that spraying the oocysts on the litter in addition to oral gavaging moved the peak of oocyst cycling ahead by a week and also appeared to trigger an earlier immune response and reduced oocyst shed in weeks 4 and 5.

Broilers: The data from the broiler trial is shown in Graph 3.



Graph 3: Weekly oocyst counts for control and groups sprayed with 1X, 5X, and 10X dose of coccidiosis vaccine on the litter.

Since there was no significant dose effect on oocyst counts of vaccine sprayed on the litter, the data was combined as for the turkey trial into sprayed and non-sprayed groups and is presented in Graph 4.



Graph 4: Weekly oocyst counts for broilers with litter either sprayed or not sprayed with additional vaccine.

The results from this trial are similar to those seen in the turkey trial in that the cycling of oocysts in vaccinated animals was moved up by a week and the oocyst counts were declining by the end of the trial.

Discussion:

Historically, coccidiosis vaccines have been sprayed in the hatchery and recycling of oocysts has been dependent on reproduction in the birds and sporulation upon excretion into the litter. This process takes approximately seven days in both chickens and turkeys and is dependent on the birds getting an adequate dose of oocysts at the outset and proper house conditions for sporulation to occur. Dr. McCarty's idea places sporulated oocysts in the environment at day zero and allows the entire process of recycling and immunity development to start at placement. For this reason the findings in these trials of advancement of peak of oocyst shed by one week are not surprising. Whether this results in a reduction in clinical disease (most notably necrotic enteritis challenge) in field situations remains to be demonstrated.

One surprise from the broiler work is that a single dose of vaccine sprayed on the litter seems to be as effective in moving up the response as multiple doses. This is important since, if this becomes a viable clinical practice, the cost of applying the additional vaccine will remain within reason especially if therapies to treat sick flocks can be minimized.

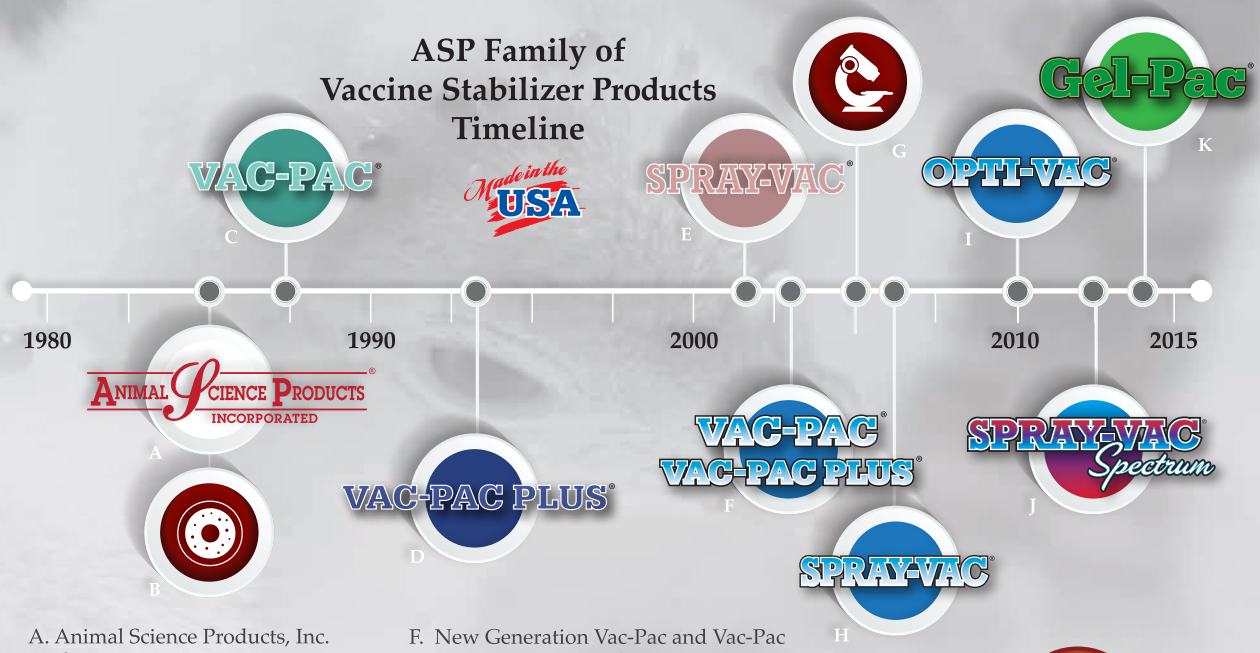
These authors would like to thank Dr. McCarty for sharing his ideas and stimulating us to do these studies. As more and more drugs to control coccidiosis are removed from our arsenals, the need to refine our ability to vaccinate birds for this disease increases. Dr. McCarty is the person who revolutionized vaccine application with his peri-vaccination lighting programs. Treatment of the litter may well prove to be the next revolution. Hopefully, he still has other ideas which he will be willing to share with the industry.

Vaccine Stabilization and Protection: A History of Innovation

Since its humble beginnings in 1985, Animal Science Products has expanded the boundaries of product development. For nearly twenty years, ASP has established a reputation as an innovator and industry visionary, eventually leading to the 2002 break-through we know today as New Generation vaccine stabilization. Once Spray-Vac, ASP's first New Generation vaccine protection product, was introduced to the market, the race was on to develop even more efficient, reliable, and cost-effective delivery methods for proper vaccination.

In just over 10 years, ASP has introduced five additional vaccine protection products, ranging in delivery methods from drinking water, to eye-drop application, to novel sprays that stimulate preening and feeding behaviors. Together, these products are changing the way poultry producers around the world protect their flocks against disease. Consumer demand for healthy poultry is on the rise globally. This demand calls for better ways to inoculate the entire flock, and is a driving factor behind ASP's commitment to innovation in vaccine protection.

ASP Family of Vaccine Stabilizer Products Timeline



A. Animal Science Products, Inc. chartered and founded as a water soluble packaging company

B. ASP introduces its first powdered milk-based vaccine stabilizer

C. Vac-Pac® vaccine stabilizer first appears, incorporating enhanced solubility and improved dose recommendations

D. Vac-Pac Plus® is introduced with added blue dye for visual vaccine monitoring

E. Introduction of Spray-Vac® – a New Generation vaccine stabilizer that eliminated the need for distilled water

F. New Generation Vac-Pac and Vac-Pac Plus introduced with patent-pending technology that improves solubility and effectiveness

G. Product development laboratory expansion

H. Spray-Vac improved to protect both viral and bacterial vaccines

I. Introduction of Opti-Vac®, a tonically-balanced ocular delivery stabilizer

J. Spray-Vac Spectrum developed with enhanced spectral response and increased preening

K. Introduction of Gel-Pac® new generation gel delivery system of vaccines, probiotics, and nutritional ingredients

Learn more at www.asp-inc.com
or contact your local BVS Sales Representative

ANIMAL SCIENCE PRODUCTS® INCORPORATED

MERCK
Animal Health

INNOVAX®-ND

TSP-V-048278 2000 dose ampules
TSP-V-116951 4000 dose ampules

Marek's Disease - Newcastle Disease Vaccine

(Serotype 3, Live Virus, Live Marek's Disease Vector)

INNOVAX®-ND is a frozen, live, cell-associated Newcastle disease (ND) and Marek's disease (MD) vaccine. It provides proven protection against virulent NDV and MD. It is approved for *in ovo* injection of 18-day embryonated eggs.

Advantages:

- Provides extended protection for virulent ND and MD
- Offers effective protection in the face of NDV maternal antibodies
- Replaces a conventional live ND vaccination program in the absence of exotic ND
- Removes the potential for respiratory reactions due to live ND vaccines
- Allows the use of monovalent infectious bronchitis (IB) vaccines, improving IB protection

NEWHATCH-C2®

TSP-V-053805 10,000 dose vials

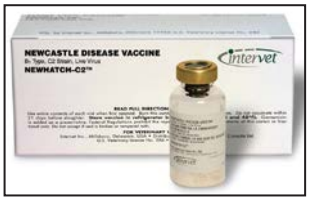
Newcastle Vaccine

(B_1, Type, C2 Strain, Live Virus)

NEWHATCH-C2® is the patented, virtually nonreactive C2 strain of B_1 Type Newcastle disease (ND) virus. It is a lyophilized vaccine approved for spray vaccination of chickens one day-of-age or older for protection against Newcastle disease.

Advantages:

- Effective against field challenge of Newcastle disease virus
- C2 strain of B_1, Type Newcastle minimizes reaction to one day-of-age vaccination in broiler chicks
- NEWHATCH-C2 eliminates problems with lingering hatchery reaction prior to field boost
- Safe to use for hatchery application



ORALVAX-HE®

TSP-V-065396 5 x 2000 dose vials
TSP-V-065398 5 x 5000 dose vials

Hemorrhagic Enteritis Vaccine (Live Virus)

ORALVAX-HE® vaccine is a high titer vaccine that safely protects turkeys 6 weeks of age or older against the immuno-suppressive effects and death losses caused by hemorragic enteritis.

Advantages:

- Safe and efficacious: produced with a stable and avirulent strain of type II avian adenovirus of pheasant origin
- Produced under federal quality control standards, ensuring purity and sterility
- Consistent high potency titers to en sure protection of every vaccinated bird, flock after flock
- Recommended administration at 6 weeks of age or older helps assure no maternal antibody interference

MERCK
Animal Health

MERCK
Animal Health

PM-ONEVAX®-C

TSP-V-065417 1000 dose units

Pasteurella multocida Vaccine

(Avirulent Live Culture, Avian Isolate)

PM-ONEVAX®-C vaccine. The seed culture used to make this vaccine hs been laboratory tested for protection of chickens against challenge with the X-73 (Type 1) strain of *P. multocida* and in turkeys against challenge with the P1059 (Type 3) strain of *P. multocida.*

Advantages:

- A temperature sensitive mutant of the CU strain that produces stronger takes than the M-9 strain, but less than the CU strain
- Offers protection against naturally occuring field strains of *P. multocida*
- Easy wing-web administration in broiler breeders, layers and turkey breeders

M-NINEVAX®-C

TSP-V-065378 1000 dose units with diluent and wing-web stabbers

Pasteurella multocida Vaccine

(Avirulent Live Culture, Avian Isolate)

M-NINEVAX®-C vaccine is a live bacterial vaccine containing the mild avirulent M-9 strain of *Pasteurella multocida*, Heddleston Type 3-4 cross, in a freeze-dried preparation sealed under vacuum.

This vaccine strain has been shown to offer protection against fowl cholera in chickens and turkeys. The seed culture used to make this vaccine has been laboratory tested for protection in chickens against *P. multocida* serotype 1 and in turkeys against challenge with *P. multocida* serotype 3.

Advantages:

- Strong protection against *P. multocida* serotype 1 (chickens) and serotype 3 (turkeys)
- Mild. Less reactive than competitive products
- Safe. Avirulent live culture will not revert to virulence, will not cause mortality
- Specially formulated diluent provides excellent reconstitution stability

ART VAX®

TSP-V-065236 1000 dose units

Bordetella avium Vaccine

(Avirulent Live Culture)

ART VAX® vaccine is a live bacterial vaccine containing a chemically induced mutant of *Bordetella avium* which is immunogenic for turkeys when vaccinated by spray cabinet at day of age; then revaccinated in the drinking water at 2 weeks of age.

Advantages:

- Approved for spray administration at day of age followed by drinking water at 2 weeks of age
- Proven efficacy in preventing coryza in turkeys
- Time proven. This vaccine strain has been used effectively in the field for over twenty years
- Mild reaction
- Freeze dried product of proven quality and stability

BVS is the exclusive distributor and marketer of Merck turkey vaccines in the U.S.

MERCK
Animal Health

BVS Personal Protection

Poly-Pro Ez Tie 4 & 6 mil

Elastic Top Boots 3 & 6 mil

Treader Boots XL & Jumbo

Shoe Cover 4 mil Clear

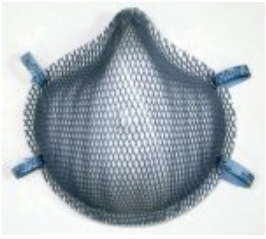
Shoe Cover 6 mil Blue

Latex Powdered Gloves

Latex Powder Free Gloves

Nitrile Powder Free Gloves

Yellow Rubber Boot Cover LG & XL



Moldex 1200N95 Mask

Moldex 2400N95 Mask

Moldex 2200N95 Mask

Nuisance Mask

Moldex Mask 7000 Series

Moldex Cartridges Multi-Gas

Moldex P100 Filter Disk

Moldex Piggyback Adapter

Navy Polypropylene Coveralls

White Micromax Coveralls

White Coveralls with Hood and Boot

Best Veterinary Solutions, Inc
1716 Detriot St.
Ellsworth, IA 50075
(888) 378-4045

Best Veterinary Solutions, Inc
325 Lakeland Dr NE
Willmar, MN 56201
(800) 533-1899

Best Veterinary Solutions, Inc
1854 East Waller Dr
Washington, IN 47501
(877) 254-3410

Best Veterinary Solutions, Inc
31024 Country Gardens Blvd
Dagsboro, DE 19939
(877) 732-3894

Best Veterinary Solutions, Inc
1 Brenneman Circle
Mechanicsburg, PA 17050
(844) 561-4918

BVS Sanititizing/Cleaning Equipment

BVS Handy Foamer

BVS Handy Foamer with Tank

Hydro Foamer 481

0.5 Gallon Foam Unit

1.3 Gallon Foam Unit

15 Gallon Conentrate Foam Unit

Concentrate Foam Unit

Doorway Foam Unit

Footwear Sanitizing Unit with Boot Scrubber

10 Gallon Fog Unit

Wall Mounted Fog Unit

Disinfection Mat

Doorway Foam Unit

0.5 Gallon Foam Unit

Best Veterinary Solutions, Inc
1716 Detriot St.
Ellsworth, IA 50075
(888) 378-4045

Best Veterinary Solutions, Inc
325 Lakeland Dr NE
Willmar, MN 56201
(800) 533-1899

Best Veterinary Solutions, Inc
1854 East Waller Dr
Washington, IN 47501
(877) 254-3410

Best Veterinary Solutions, Inc
31024 Country Gardens Blvd
Dagsboro, DE 19939
(877) 732-3894

Best Veterinary Solutions, Inc
1 Brenneman Circle
Mechanicsburg, PA 17050
(844) 561-4918

NEW!

AviCare™

PRODUCTION CHALLENGE?

AviCare is an all-natural nutritional health product for inclusion in poultry drinking water during production challenges.

Add **AviCare** to your risk management program.

Distributed by:

BVS
Best Veterinary Solutions

Diamond V®
The Trusted Experts In Nutrition & Health®

For more information call 800-373-7234. Subscribe to our *PoultryAdvisor* e-newsletter at www.diamondv.com

The world's leading disinfectant Virocid has become even more powerful.

Thanks to the extraordinary cleaning power of **Kenosan**, the world's most powerful disinfectant **Virocid** is able to penetrate deeper and disinfect even more thoroughly than you were used to.

Kenosan combines ultra-strong adhesion power and deep penetrating cleaning action at very low dilutions! The high-level formulation guarantees a unique cleaning result in the most heavy-duty circumstances in the pig, poultry and dairy houses. Even the most thick and dried up dirt (manure, litter, etc.) like in farrowing crates, fattening pens, turkey or broiler rearing houses, milking parlours etc. stands no chance against the penetrating and dissolving power of Kenosan. The cleaning action also gets amplified by extended contact time due to the sticky foam that remains attached upon all types of surface.

CID LINES
innovative hygiene solutions

www.cidlines.com

Healthy profits start from within

Good intestinal health is key to maximizing uniformity, productivity and profitability in your operation. New **Safe-Guard® AquaSol** helps you optimize treatment of poultry gastrointestinal worms with an innovative, farm-friendly drinking water formulation.

- **Smaller particle size helps prevent sedimentation and clogged pipes, filters and nipple drinkers**
- **No pre-slaughter withdrawal**

safe-guard® AquaSol
(fenbendazole oral suspension)

No withdrawal period is required when used according to the label. Do not use the drug in laying hens and replacement chickens intending to become laying hens. Consult your veterinarian for assistance in the diagnosis, treatment and control of parasitism.

THE SCIENCE OF HEALTHIER ANIMALS.

US/PAQ/0815/0002

MERCK Animal Health

CAL STAT® PLUS
ANTISEPTIC HANDRUB WITH ENHANCED EMOLLIENTS

Cal Stat Plus Antiseptic Handrub with Enhanced Emollients is a 63% (v/v) isopropyl alcohol-based handrub designed to effectively decontaminate visibly clean hands of healthcare workers before and after patient contact, and after contact with inanimate objects. In a time kill study, Cal Stat Plus Antiseptic Handrub with Enhanced Emollients demonstrated complete kill in 15 seconds against a broad spectrum of transient microorganisms including methicillin-resistant Staphylococcus aureus (MRSA) and vancomycin-resistant Enterococcus faecium (VREF). The product is formulated with a moisturizing system, adding moisture to the skin after every use. This dermatologist-tested, dye-free isopropyl alcohol-based handrub can be used in all areas of healthcare settings.

PHYSICAL PROPERTIES

Form	Liquid
Color	Colorless
Fragrance	Baby powder
Typical specific gravity	0.891
Antiseptic ingredient	Isopropyl alcohol (63% v/v)

DIRECTIONS FOR USE

Wet hands thoroughly with Cal Stat Plus Antiseptic Handrub with Enhanced Emollients and rub until dry.

Storage: Do not store at temperatures below 32□F (0□C).

Flammable, keep away from fire or flame.

ALCARE®
FOAMED ANTISEPTIC HANDRUB

Fast-acting, broad-spectrum antimicrobial action, including MRSA and VRE

Alcare Foamed Antiseptic Handrub is an alcohol-based handrub with fast-acting, broad-spectrum antimicrobial action against pathogenic microorganisms. Alcare Foamed Antiseptic Handrub also has proven activity against multiply resistant microorganisms such as methicillin-resistant *Staphylococcus aureus* (MRSA) and vancomycin-resistant *Enterococci* (VRE). The Alcare Foamed Antiseptic Handrub formulation of 62% ethyl alcohol and emollients provides hand antisepsis and moisturizing at the same time. Alcare Foamed Antiseptic Handrub spreads easily to facilitate even distribution over all skin surfaces for effective disinfection. Alcare Foamed Antiseptic Handrub is convenient to use when there are no handwashing facilities available and hands are physically clean, but in need of degerming and can be used as an adjunct to handwashing when extra protection is desirable.

Storage: Protect product from freezing. Store and use at 55-85□F (12-29□C); do not store above 120□F (49□C).

PHYSICAL PROPERTIES

Form	Foam
Color	White
Fragrance	Mild alcohol
Antimicrobial	62% (v/v) ethyl alcohol

DIRECTIONS FOR USE

Surgical Scrub

Clean under nails with a pick. Nails should be maintained with a 1 mm free edge. Dispense 5 g (about the size of a tennis ball) onto one hand. Spread on both hands paying particular attention to the nails, cuticles and interdigital spaces and forearms. Rub into skin until dry. Dispense 2.5 g (approximate size of a golf ball) onto one hand and spread over both hands and the wrists and rub into the skin until dry.

Healthcare Personnel Handwash

Apply product to hands and rub until thoroughly dry.

NEEDS NO WATER · CONTAINS EMOLLIENTS

STERIS®

STERIS Corporation
5960 Heisley Road
Mentor, OH 44060-1834
440-354-2600 · 800-548-4873
www.steris.com

FIND FAST. KILL QUICK.

Elanco

Agita® 10 WG™

House flies and litter beetles can't hide from the quick kill and long-lasting residual of Agita's unique, potent active ingredient.

See how a first-choice for fly and beetle control can help protect your poultry house at Elanco.us/Agita

REDUCE DISEASE TRANSFER[1]

DUAL MODES OF ACTION

MANAGE RESISTANCE[2]

[1]Grogan K. Beetles and houseflies play role in disease transmission. Poultry Times. August 25, 2008.
[2]Elanco Animal Health, 2014. Data on file.

The label contains complete use information, including cautions and warnings. Always read, understand and follow the label and use directions. Animals cannot be present at time of premise treatment.

ANIMAL SCIENCE PRODUCTS®
INCORPORATED

Gel-Pac™

GEL DELIVERY SYSTEM FOR POULTRY

VACCINES • PROBIOTICS • NUTRITIONALS

ADVANTAGES

- STABLE GEL ENSURES UNIFORM SUSPENSION
- PERFECT FOR INSOLUBLE INGREDIENTS
- INDIVIDUAL GEL DROPS ARE EASILY CONSUMED
- WILL NOT SOAK FEATHERS
- READILY VISIBLE TO THE BIRDS
- IDEAL FOR USE IN GEL DELIVERY SYSTEMS

Made in the USA

FOR MORE INFORMATION ON GEL-PAC VISIT ASP-INC.COM/GEL-PAC OR SCAN THE QR CODE

Efficacy of Gel-Pac Application for Poultry Coccidiosis Vaccination

Avoiding sub-clinical coccidiosis in poultry is an important element of efficient production. Sub-clinical coccidiosis robs profit from each flock, and the extent of the damage can amplify from flock to flock through oocyst cycling, eroding each successive flock's performance like waves during a rising tide. Coccidiosis control was achieved initially with antimicrobial drugs (Levine, 1939), and later with vaccines (Edgar, 1956). Antimicrobial drugs are coming under more regulatory scrutiny, and ionophore anticoccidials are also avoided as a means of improving consumer perception by some poultry integrators. These shifts are driving the industry to seek optimum protection from vaccines. **Efficiently improving vaccine protection has been the aim of a number of different vaccination techniques, and the key objectives have been to obtain early onset of immunity and more uniform vaccine exposure among the birds in a flock**.

In employing different strategies to obtain faster onset of protection and better uniformity, producers vaccinate variously by dosing drinking water after placement, misting aerosol on birds at hatch, spraying edible gel droplets on hatchlings, spraying vaccine on feed at placement, eye dropping, and, more recently, injecting *in ovo*. A study comparing a number of these vaccination methods, followed by a coccidiosis disease challenge, concluded that coccidiosis vaccine is more effective in terms of live performance and lesion scores when it is administered orally (feed or water) than when given by aerosol mist or eye drop (Firouzi, *et al*., 2014). One complication in the Firouzi *et al*. report is that their in-feed vaccine was consumed on day 3, not day 1. Recognizing that coccidiosis vaccines perform best when they are directly consumed, and that vaccines applied in the hatchery give immunity a head start while being easier to manage, stimulates interest in improving early oral vaccine consumption. It adds weight to the notion that an ideal solution is an early hatchery application that also permits direct consumption of more concentrated vaccine. Dewaele and Degussem (2016), designed a study to compare vaccine applied to day-old hatchlings in a stabilized edible gel (Gel-Pac®, Animal Science Products, Inc.) versus vaccine sprayed on feed for day-old chicks.

Objective

The objective of the study was to evaluate HuveGuard-Start® application via an edible gel spray, compared to spray vaccination via the feed on the first day of life. Researchers assessed the oocyst excretion (cycling) pattern in feces in broilers under battery conditions after vaccination on day 1, and investigated the immune protection of both vaccine applications against a challenge with *Eimeria spp*. isolated from broiler chickens in the field. The efficacy of

these treatments was assessed by surveying daily weight gain (DWG), feed conversion ratio (FCR), intestinal lesion scoring (ILS) and oocyst shedding, compared to an infected non-vaccinated control (INC) group and an uninfected non-vaccinated control (UNC) group.

Methods

Fifteen animals per group were allocated to four different groups depending on the vaccination they received, with three replicates per treatment group. Cardboard was placed over the grid of the birds' cages from d1 to d20 to allow re-infection with the vaccine strain.

Gel-Pac® Accelerates and Strengthens Coccidiosis Vaccine Cycling

Pooled fecal samples from each cage were collected daily after vaccination between d6 and d20. An oocyst per gram (OPG) count was performed on the pooled fecal samples.

On d9, d14 and d19, five individual droppings per cage were collected for semi-quantitative analysis of vaccine oocyst presence, surveyed on a scale of 0-3.

On d20, animals were allocated to four different treatment groups depending on the vaccination that they received on d1. The four experimental groups formed one block each, which was replicated seven times. The birds were divided among 7 cages per group containing 5 birds each. Subsequently, in both the INC and all the vaccinated groups, the 5 birds in each cage were inoculated orally with a challenge mixture of *Eimeria* species isolated from the field. On d27, seven days after the challenge, all animals in each cage were euthanized and necropsied for coccidiosis lesion scoring. Scoring was performed following Johnson and Reid (1970), for the species relevant to broilers described in this scoring system (*E. acervulina, E. maxima* and *E. tenella*).

Results

Chicks vaccinated on the first day of age began excreting detectable oocysts on day 7. The number of oocysts excreted in the first cycling wave from d7-11 were greater for those vaccinated via gel than via feed (Figure 1). That pattern of amplified early vaccine cycling persisted through d20, with the vaccine OPG from gel exceeding that of feed on all days except d20.

In addition to generating more early vaccine cycling, the vaccine sprayed in gel was more uniformly present among the birds than the vaccine sprayed on feed, indicated by a greater proportion of gel-spray fecal samples being positive for vaccine oocysts surveyed on d9, d14, and d19 (Figure 2). For gel-immunized birds, d9, d14, and d19 percent positives were 53%, 67% and 93%, respectively, compared to 7%, 7%, and 60% for feed spray. **Beyond gel providing a greater proportion of positive fecal samples, each positive sample was also more densely populated than those from chicks vaccinated by sprayed feed (Figure 3)**.

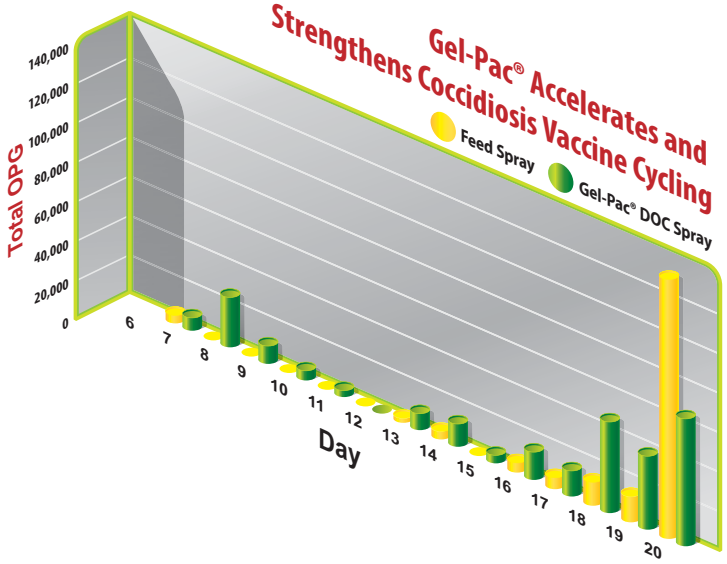


Figure 1: Total *Eimeria* OPG of 3 pooled fecal samples per group daily between d6 and d20.

The harmful effect of the challenge on non-protected birds was marked. During the 7d post-challenge the chick DWG and FCR for UNC were 65.7g and 1.863 respectively, whereas the INC group worsened ($P<0.05$) under the pressure of the challenge to 32.1g

Gel-Pac® Increases Coccidiosis Vaccine Uniformity

DWG and 3.199 FCR. Post-challenge growth and conversion during the 7d period did not differ between the two vaccine treatments (Table 1).

Intestinal lesions assessed 7d following challenge appropriately reflected the severity of the infection, with INC birds having significantly more total lesions, scored at 3.71, than UNC scored at 1.29 ($P<0.05$). Feed spray scored 3.37, which was not significantly lower than unvaccinated birds. **Gel spray, in contrast, did protect birds significantly better, with lesions scoring 2.86 ($P<0.05$) (Table 2). The improved lesion scores arising from the vaccine delivered in Gel-Pac was linked to fewer numbers of infectious challenge organisms**. Mean OPG 7d after challenge was markedly lower in both vaccinated groups than those that were not immunized, and the lowest OPG existed in the gel-vaccinates. Total infectious coccidia in non-vaccinates numbered 313,421 OPG, those vaccinated in feed had 73% fewer at 85,991, and gel-vaccinate lesions reduced 88% to 38,189 (Table 3).

Intuitively, and borne out by the Firouzi *et al.* results, coccidiosis vaccination techniques that facilitate the most direct consumption of vaccine are also the most protective, and earlier immunity is preferred. There were significant differences among the two direct oral vaccination techniques compared in this study. Vaccine administered in Gel-Pac yielded greater early vaccine oocyst cycling that persisted through d19, and the stronger vaccine numbers were more uniform among the gel-vaccinated chicks. The improved vaccination did result in better protection against the challenge by field organisms. More complete protection was evident in gel-vaccinates, which had by far the fewest number

Gel-Pac® Increases Vaccine Oocyst Density Score

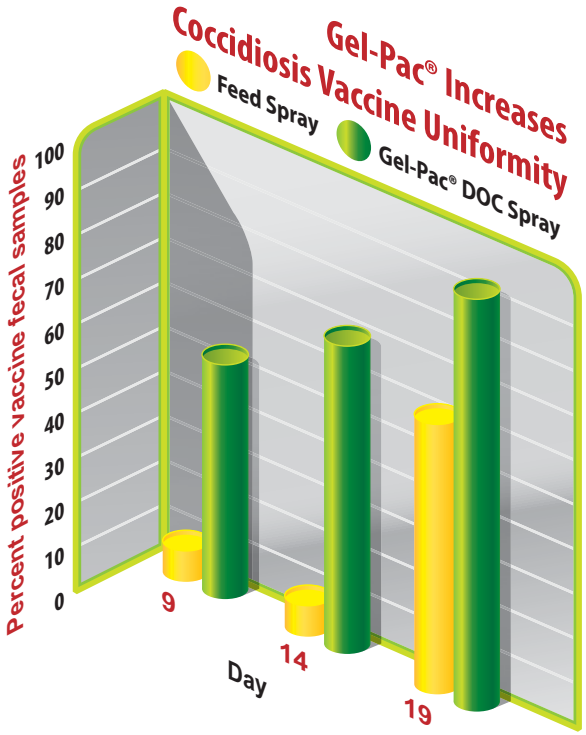


Figure 2: Gel spray increased the percent of individual fecal samples (n=15 samples/group/d) found positive for *Eimeria* vaccine oocysts.

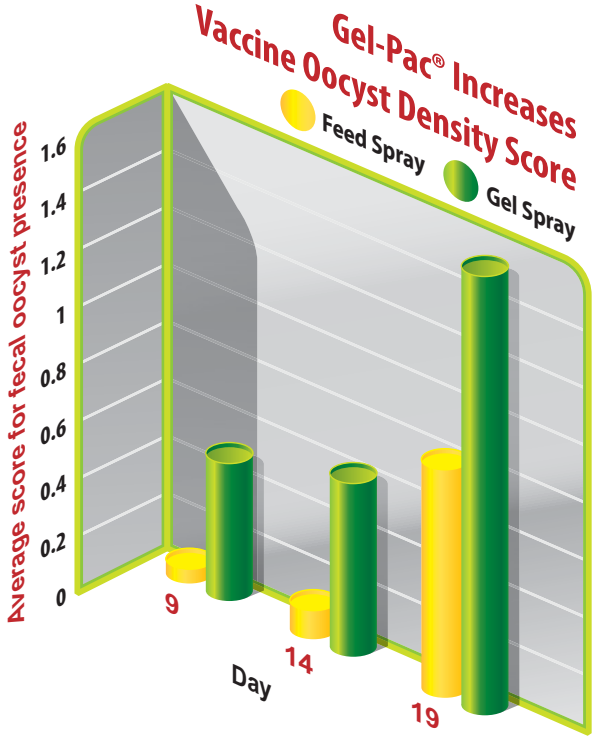


Figure 3: Fecal samples found positive for vaccine oocysts were more densely populated in Gel vaccinated v. Feed vaccinated chicks. Average score of individual fecal samples (n=15 samples/group/day) graded for density of *Eimeria* oocysts. Microscopic oocyst density score: 0 = no oocysts present, 1 = some oocysts present, 2 = oocysts present in all fields, 3 = full of oocysts.

of residual infectious challenge organisms, resulting in the lowest lesion scores.

Table 1: Least square means of DWG and FCR for the different treatment groups during the post-challenge period from day 20-27

Group	DWG, g	FCR
UNC	65.7[a]	1.863[a]
INC	32.1[c]	3.199[b]
Feed Spray	55.8[b]	2.104[a]
Gel Spray	53.5[b]	2.078[a]

[a,b,c] for each study, different superscripts within column indicate a significant difference (P<0.05).

Beyond the benefit of more protective coccidiosis immunity, Gel-Pac also provides options for better hatchery efficiency. Gel-Pac, a powdered concentrate that hatcheries mix with tap water or well water, also stabilizes live virus vaccines such as infectious bronchitis and Newcastle disease, bacterial vaccines and probiotic bacteria. It is engineered to safely carry these other oral additives in one single edible gel suspension that does not require constant agitation and does not soak hatchlings. **Gel-Pac is the ideal solution for more efficient, early hatchery spray.**

Table 2: Mean *Eimeria* associated intestinal lesion scores (ILS) 7 days after challenge

	ILS			
Group	*E. acervulina*	*E. maxima*	*E. tenella*	E. Total
UNC	0.54	0.46	0.29	1.29[a]
INC	0.72	1.16	2.19	3.71[c]
Feed Spray	0.50	1.53	1.44	3.37[bc]
Gel Spray	0.24	1.15	1.56	2.86[b]

[a,b,c] for E. total, different superscripts within column indicate a significant difference (P<0.05).

Table 3: OPG for *E. acervulina, E. tenella, E. maxima, E. praecox* and *E. mitis* and total count (sum of OPG for each spp) 7 days following challenge, mean of 7 cages per group

	OPG					
Group	*E. acervulina*	*E. tenella*	*E. maxima*	*E. praecox*	*E. mitis*	Total
UNC	0	0	0	0	0	0
INC	154,816	81,633	35,241	39,339	2,391	313,421
Feed Spray	79,220	1,754	2,723	42	2,252	85,991
Gel Spray	28,566	3,010	4,674	118	1,821	38,189

[a,b,c] for E. total, different superscripts within column indicate a significant difference (P<0.05).

Literature Cited

Dewaele, I. and DeGussem M., 2016. Efficacy of Gel-Pac application for coccidiosis vaccination. Personal communication.

Edgar, S. A., 1956. Coccidiosis of chickens and turkey and control by immunization. In: Proceedings of the World Poultry Congress, 11, pp. 1–19.

Firouzi, S., N. Mosleh, S. S. Tohidi Far, M. J. Taebipur & G. Farjani Kish, 2014. Efficacy of anticoccidial vaccination of chickens via different routes: A comparative study. Bulg. J. Vet. Med. (online first).

Johnson, J., & Reid, W. M. (1970). Anticoccidial drugs: Lesion scoring techniques in battery and floor-pen experiments with chickens. Experimental parasitology, 28 (1): 30-36.

Levine, P. P., 1939. The effect of sulfanilamide on the course of experimental avian coccidiosis. The Cornell Veterinarian, 29, 309–320.

OMEGAMUNE-PLUS®

JUST RECEIVED! Patents #8,298,593 #8,460,719

WITH ANTIOXIDANTS FOR TURKEYS & BROILERS

For Use in Closed Drinking Water Systems for Poultry

GUARANTEED ANALYSIS

$CuSO_4$.....18%

INGREDIENTS: Copper, Organic Acids, BioSupremeL, Buffers, Dye #40, Extract from Essential Oils.

Omegamune-Plus *Precautions*

- Acidic solution
- Corrosive to galvanized and mild steel equipment, piping and/or fittings.
- Wear goggles or full face shield when handling
- For animal use only; not for human consumption
- Keep out of the reach of children

WARNING: ***Follow label directions***

MIXING DIRECTIONS

Standard Dosage - 1:1024 gallons drinking water. Administer 1 part Omegamune-Plus in 1024 parts drinking water. For injectors/proportioners administer 1 oz. stock solution per gallon drinking water. Prepare stock solution by mixing 1 gallon Omegamune-Plus with 7 gallons water.

Optimum Dosage - 1:512 gallons drinking water. Administer 1 part Omegamune-Plus in 512 parts drinking water. For injectors/proportioners administer 1 oz. stock solution per gallon drinking water. Prepare stock solution by mixing 1 gallon Omegamune-Plus with 3 gallons water.

Available in the following packaging:

4 x 1 gallon cases.....(Product # 100801)
5 gallon pails.....(Product # 100810)
55 gallon drums.....(Product # 100820)

Manufactured by: **Best Veterinary Solutions, Inc. • Willmar, MN 56201**
1-800-533-1899 • FAX 320-235-8629
"Marketed Exclusively by Best Veterinary Solutions"
Contact the BVS sales representative or distributor in your area for more details.

Get into the Zone

The Manage® Zone
Dietary Agent for Poultry and Swine

- is considered GRAS (generally recognized as safe).
- has a pH of 1.3.
- when mixed at recommended levels will reduce drinking water to pH 3.5-5.5.
- will hold pH down longer than other commercially available acidifiers.
- contains higher levels of copper than other liquid copper products on the market.
- can be used in place of Chlorine or Iodine.
- is a dark purple solution that stays in solution without any settling out like that of competitive products.
- fits well into an antibiotic free program.
- works very well to maintain waterlines. Prevents scale and slime build up.
- is friendly to the environment. 40% less copper excreted by using Manage versus feed grade copper.
- Is the only Patented product of its kind!

The Acid Sol® Zone
Dietary Agent for Poultry and Swine

- is considered GRAS (generally recognized as safe).
- has a pH of 1.3.
- when mixed at recommended levels will reduce drinking water to pH 3.5-5.5.
- will hold pH down longer than other commercially available acidifiers.
- can be used in place of Chlorine or Iodine.
- is a red solution that stays in solution without any settling out like that of competitive products.
- fits well into an antibiotic free program.
- works very well to maintain waterlines. Prevents biofilm build up.
- is a combination of buffered acids.
- contains No copper.

Marketed Exclusively by Best Veterinary Solutions, Inc.
Wilmar, MN 56201
800-533-1899
FAX 320-235-8629

Contact the BVS sales representative or distributor in your area for more details, or call 1-800-533-1899.

GUT PRO™

Microbial Ecology and Its Important Role.

Recent advances in microbial ecology continue to identify the important role the complex gastrointestinal microbiome plays in the health and wellbeing of animals and humans. Initial colonizing bacteria of the gastrointestinal tract play a vital role in the development of the immune system, establishing intestinal microbial homeostasis, and impacting digestion and nutrient absorption.

Modern commercial practices of hatchery hygiene and the use of *in ovo* antibiotics have led to an inconsistent level of total bacteria and specifically lactic acid bacteria in chicks and poults. Although these practices are effective in reducing egg contamination and disease transmission, they have the undesirable effect of causing highly variable bacterial colonization of the GI tract. In essence, modern practices have contributed to removal of beneficial bacteria from the laying hen.

What is Microbial Terroir?

Our Microbial Terroir™ technology is the foundation of our research and development. Terroir, loosely translated as sense of place, is the embodiment of the sum of the effects of the local environment on the characteristics of a product. It includes the microbiota of the host, environment, feed, and water.

In the case of poultry - the microbial terroir of the gastrointestinal tract interacts with the host immune system (acquired and innate), litter, and feed components. This interaction is critical for the health and performance of the bird.

Powering Your Microbial Terroir™

GUT PRO™ gives them an edge from the start

Immune development and immune function

- Acquired immune system (B and T cells)
- Innate immune system (mucin chemistry)

Microbial homeostasis

- Lactobacillus - Microbiome makes up the complex community that acts as barrier to infection
- Bacillus - Production of bacteriocins to ensure low levels of pathogenic challenges

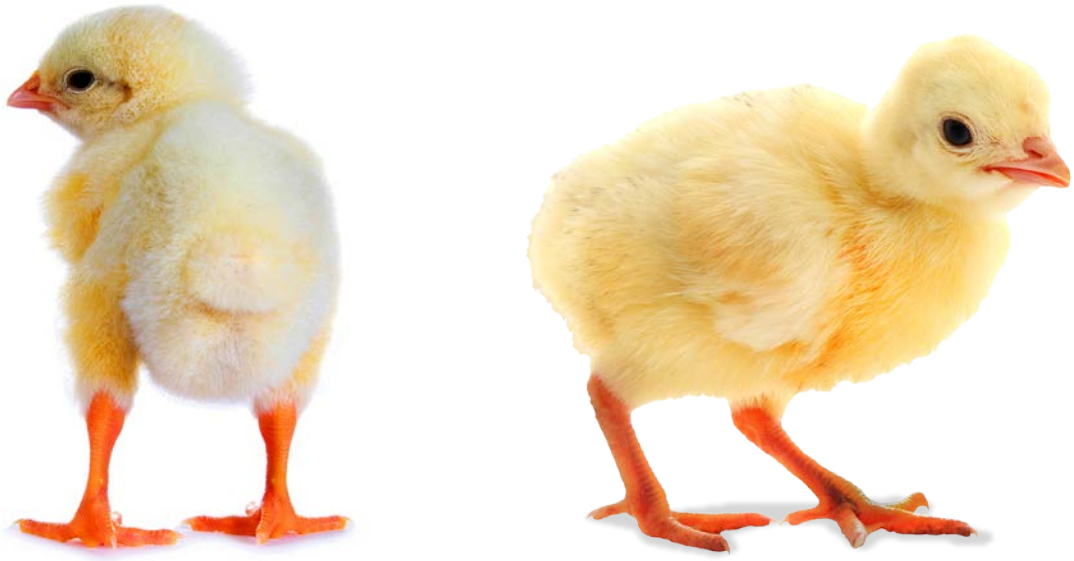
Nutritional processing

- Microbiome processes complex feed ingredients more readily absorbed
- Processes phytochemicals (polyphenols) - improves function and bioavailability

GUT START® & GUT PRO™

Powered by Microbial Terroir™

Technology by Agro BioSciences, Inc.



Now with **new strains.**

BioProteXion
by CID LINES

COMPLETE SANITATION PROGRAM FOR FIELD AND HATCHERIES

BIOGEL

- The strongest cleaner
- Gel clings on longer than classical foam = superior cleaning result

KENOSAN

- Deeply penetrating alkaline foam for farms, incubators, trucks, …
- Apply at 1 to 1 ½ oz / gal only with a foam wand.
- Non corrosive in dilution.

VIROCID®

- EPA approved "broad spectrum disinfectant"
- QAC/glutaraldehyde based, dil 1/3 oz – ½ oz/gal
- Non corrosive
- Apply by spray, foam or (thermo) fog
- Maintains pad cooling systems

KENO™ X5

- EPA approved "broad spectrum disinfectant"
- Per Acetic Acid based, dil ½ oz/gal
- 100% biodegradable

CID 2000

- H2O2 removes heavy soils
- Peracetic Acid removes scale / mineral build up
- Equipment friendly
- Proven "greatest reduction in microbial load" by U. of Arkansas

CID CLEAN

- 50% Stabilized Hydrogen Peroxide
- H2O2 removes heavy soils
- Equipment friendly
- NO heavy metals

BEST VETERINARY SOLUTIONS,INC.
Ellsworth, IA.....888-378-4045
Willmar, MN.....800-533-1899
Washington,IN.....877-254-3410
Dagsboro, DE.....877-732-3894
Manheim,PA.....717-940-4805

CLEARVIEW ENTERPRISES
Tontitown,AR.....866-361-4689
Monroe, NC.....704-219-7959

K SUPPLY CO.
Albertville, AL.....256-894-0034

VET SERVICE
Fresno, CA.....559-485-7474

POULTRY TECH SERVICE
Gainesville, GA.....770-287-7891

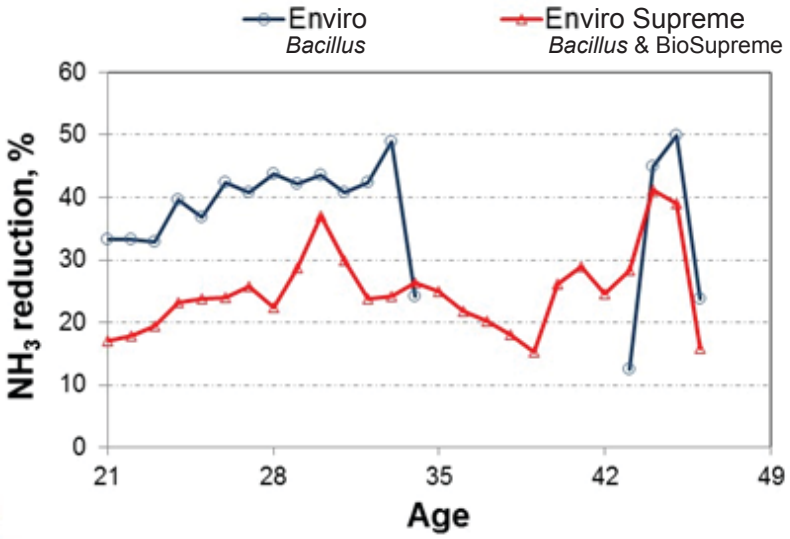
CID LINES
innovative hygiene solutions

www.cidlines.com
www.bestvetsolutions.com

Reduce Daily Ammonia Levels During Grow Out with **Enviro**™ and **Enviro Supreme**™

- University Research shows Enviro Supreme reduced NH_3 throughout the flock by 15-40%
- Results indicated that both Enviro and Enviro Supreme reduced NH_3 throughout the 7 week trial period
- This data supports the ammonia reduction seen in commerical production systems

Daily mean ammonia reduction rates of two dietary additives (data points from 35 to 42 for En and 47 to 49 for both are missing due to water leakage and room temperature control malfunction)



Powered by

Microbial Terroir™

Technology by Agro BioSciences, Inc.

For More Information Visit www.bestvetsolutions.com
or contact your local BVS rep

STRATEGIES TO IMPROVE LITTER QUALITY

INTRODUCTION

The condition or quality of litter has a direct impact on the health, performance and quality of birds and also the microbiological safety of poultry food products. The quality of litter can be defined by the combined physical, biological and chemical properties and how they impact the environment for raising birds and the resulting direct consequences on the performance and health of the birds and quality of the food products.

Of the three properties defining the quality of litter, the biological properties, or more appropriately, the microbiological properties of litter is the most important. Microorganisms in litter are directly responsible for the decomposition of uric acid that results in ammonia. Microorganisms in litter are also important pathogens to the birds and can represent a significant food safety risk. The chemical and physical properties of litter directly impact the microbiological properties. Understanding how these factors interact is key to developing strategies to improve litter quality.

FACTORS AFFECTING LITTER QUALITY

Controlling the condition of litter in poultry houses is essential to ensure a better environment and thus better health and performance of the birds. An understanding of the physical and chemical properties of litter that affect the growth and survival of the pathogenic and ammonia producing microorganisms in litter will allow producers to implement management techniques to prevent or retard these microorganisms.

The condition or quality of litter can be affected by a number of factors. Chemical properties such as moisture content and litter pH as well as the physical friability of the litter are some of the most important factors that affect litter quality.

Litter moisture, which is more accurately described by litter water activity (aw), is a measure of the unbound or available moisture in litter. This is in contrast to water that is bound to the nutrients and other compounds in litter and is not available for microorganisms. Researchers at the University of Maryland have found that the water activity of the litter surface correlates with the incidence of salmonella on the farm and on the carcasses of broilers. Therefore, controlling litter surface water activity is an important method to reduce the incidence of salmonella and other microorganisms in the litter environment.

Litter pH is another critical factor affecting litter quality. The pH of litter is alkaline and typically ranges from 7.5-8.5 due to the accumulation of ammonia and fecal material. It has been well established that most microorganisms grow best at pH values near 7.0 while few grow below 4.0. Reducing litter pH as a means to control microorganisms would require reducing and maintaining the litter pH below 4.0. Unfortunately, this is not practical given the neutralizing capacity of litter. However, maintaining the litter pH at 7.0 will result in less ammonia volatilization since more ammonia will be in the ionized form (NH_4^+) at this pH.

Friability is a physical property of the litter that directly impacts litter aw. Friability is a measure of how easily the litter will crumble or break-up. Practically speaking, the more friable the litter, the easier it is to break-up and less likely to mat and hold water on the surface.

MANAGEMENT PRACTICES TO IMPROVE LITTER QUALITY

Given the importance of litter as a critical step in the overall process of poultry production, producers are searching for management practices to improve litter conditions. Implementing management strategies that directly affect the physical and chemical properties of litter will, in turn, affect the microorganisms in litter and

result in improved litter conditions. This will ultimately ensure better bird performance and health, and safer food products.

The most direct way to impact litter quality is to reduce litter aw. Proper management of ventilation, drainage around the houses, drinkers and fogging / sprinkler systems will help to minimize litter aw. Low litter aw will reduce the growth of pathogenic and ammonia producing microorganisms.

Another way to impact litter quality is to improve litter friability. Practices such as removing the crusted or caked litter and tilling litter between flocks will help to improve the friability of the litter. Selecting litter materials that won't mat and will release moisture will also help to maintain better friability. The more friable the litter, the lower the litter aw.

Litter treatment products offer producers another way to affect the physical and chemical properties of litter. At present, a number of commercial litter treatment products have been reported to reduce ammonia levels in poultry houses but few products have been shown to improve and maintain the microbiological quality of litter. Current chemical treatments on the market have the advantage of rapidly lowering the pH of the litter. These products will control ammonia and possibly microbial activity for an initial period but these treatments are quickly neutralized by the alkaline conditions of litter and therefore may only be effective for a short period of time.

ENVIRO SUPREME – A BIOLOGICAL APPROACH

Research on the use of microorganisms as biological control agents indicates that this is a fundamentally sound concept. Unlike chemical treatments, biological treatments can reproduce in the litter and maintain an effective concentration of the microorganisms in the litter.

ENVIRO Supreme is built from the combination of specific strains of Bacillus subtilis and Bacillus licheniformis and the Yucca schidigera in BioSupreme. This unique and powerful product targets the litter environment with an immediate and proactive approach. This is crucial when time is of the essence for veterinarians, nutritionists and production managers to make positive impacts. Immediate: the Yucca schidigera provides the ability to immediately minimize the noxious odors and ammonia that are already present in production environment through a binding action by the Yucca schidigera. Proactive: the continual feeding of ENVIRO Supreme allows the Bacillus spp. to accumulate in the environment as they are shed in the feces, providing a long term approach to maintaining quality litter conditions.

The immediate and proactive approach of ENVIRO Supreme allows the product to respond to the continually changing and challenging environment of typical poultry production conditions. Additionally, research indicates that there are additional secondary benefits from inclusion of Yucca schidigera extract in feeds, specifically, an increase in animal weight gain and better feed utilization. Adding to the cost effectiveness of ENVIRO Supreme is the need for only one micro bin at the feed mill. A huge advantage for space limited feed mills.

Overall, the best litter management technique may be to utilize multiple techniques to build not one, but rather a series of strategies to effectively control litter quality. ENVIRO Supreme offers the unique opportunity to implement two interventions strategies in one product while taking both an immediate and proactive approach to managing environmental litter conditions. The synergistic mode of actions of the Bacillus and Yucca schidigera products make ENVIRO Supreme a product of immense value to poultry producers.

Water-soluble additives

Powerful start

Optimization of energy supply via drinking water.

LOVIT LC-ENERGY

Get your chicks started with our liquid supplement Lovit LC-Energy. This balanced liquid formulation consists of L-carnitine, betaine, sorbitol and magnesium sulphate. These increase the conversion of energy and protein in the first days of life and during all critical production phases which are characterized by metabolic stress. Lovit LC Energy also supports liver functionality.

Lohmann Animal Nutrition

Lohmann Animal Nutrition GmbH
Zeppelinstr. 3
27472 Cuxhaven - Germany
Phone: +49 (0) 4721 5904 0

www.lohmann-animal-nutrition.com

Liquid robustness

Egg shell and bone stability via drinking water.

LOVIT
PHOS PLUS

Strong bone structure and high quality of egg shells is a constant challenge in poultry flocks. Lovit Phos Plus Liquid consists of a balanced combination of minerals and trace elements in a highly available formulation. The low pH value of the product can further support intestinal health. This guarantees high efficiency for systematic supplementation via drinking water.

Lohmann
Animal Nutrition

Lohmann Animal Nutrition GmbH
Zeppelinstr. 3
27472 Cuxhaven - Germany
Phone: +49 (0) 4721 5904 0

www.lohmann-animal-nutrition.com

pH Matters
by JONES-HAMILTON CO.

JHAg
WE KNOW pH MATTERS

SUMMER 2016

Litter Management for Improved Health and Welfare

by Blake Gibson

Litter management is an evolving process. Just when we think we're getting it right, things change. Changes in production, such as different bird sizes, densities and the introduction of more ABF and organic programs, demand a constant review of a litter management program. Without it, producers can easily step back on their litter management effectiveness, which can impact paw quality and overall bird health and welfare.

In every production model, the physical and biological characteristics of litter are ever changing as well. This is important to note since physical characteristics of litter, combined with diet, continues to cause the majority of paw and air quality issues. The physical changes are due to a shift in:

- **Housing improvements**
- **Litter types**
- **The longevity/quality of the litter**

Through the careful management of ventilation, water and litter practices, production can be optimized.

Impact of Ventilation and Waterline Management on Paws

In general, recent industry expansion has improved poultry housing. House designs accommodate better directional airflow in an attempt to maximize air speed efficiencies through better ventilation models. Proper ventilation, along with improvements in monitoring and measuring relative humidity, helps maintain better floor conditions. This is notable because the two factors that need to be present for paw lesion development are substantial levels of ammonia deep in the litter and moisture at the litter surface. Houses with no or low ammonia at bird level can still have a substantial percentage of paw lesions if the litter is damp. This is most commonly seen in brand new houses or on new litter where the relative humidity is high even though the ammonia is not. Litter slicking occurs with ammonia in its liquid state.

The formation of liquid ammonia at the litter surface occurs anywhere there is even the least bit of damp litter. The severity and moistness of the cake present in the house seems to play the predominant role in lesion development. Common culprits are small wet spots under the drinkers (commonly referred to as donuts) and caked areas along the sidewalls. When newly hatched chicks step onto those damp areas, the litter sticks to their feet and ammonia in the litter begins to erode the skin. Visible paw lesions are evident by the time the bird is 7-10 days old and the lesions continue to worsen over time. Early paw scores can raise the red flag for pre-brooding and brooding problems.

Waterline Management BMPs

Waterline management is one of the most critical components of litter Best Management Practices (BMPs). Waterline management has been a topic of discussion since the development of commercial watering systems. With the evolution of the nipple drinker, management of the system has a tendency to be critical only at placement. The weekly turn of the crank to raise the line slightly is seen as mandatory but the importance of micromanaging water pressure, flow and micro-leveling throughout the flock gets minimized.

Without this micromanagement, litter quality diminishes when surplus water, un-level lines and worn out nipples create a wet environment under the water system. That extra moisture combines with ammonia gas to generate liquid ammonia which starts the damage to paw tissue. Wet litter is also a great breeding ground for the bacteria that infect the paw lesions causing even more damage to the bird.

Impact of Ambient Ammonia on Bird Health

While ambient ammonia levels do not seem to influence the development of paw lesions, it does have a significant impact on bird health–reducing food consumption, growth rate and carcass quality at 50-75 ppm, and impacting respiratory functions and eye health at just 25 ppm. Proper ammonia monitoring is crucial to maintain health and performance.

Traditionally, many producers make air quality decisions based on observations about ammonia at five to six feet above ground level and then only at placement. However, we in the poultry industry cannot rely on our senses. Proper ammonia monitoring devices must be used and at the appropriate time and place.

Work done by D. Miles on ammonia stratification (Fig. 1) demonstrated how recorded ammonia levels decreased as readings were taken farther away from the floor. Ammonia concentration at bird level shows the true impact on the flock.

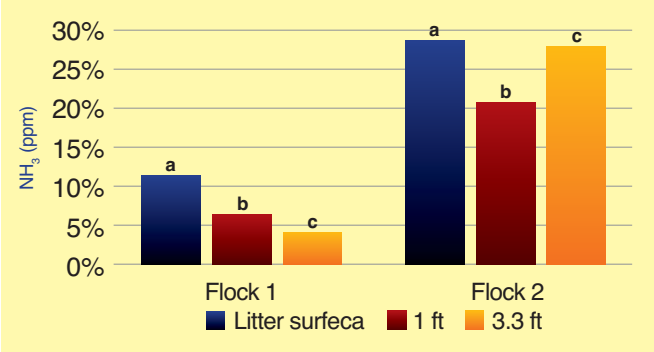


Figure 1. Ammonia stratification

The amount of nitrogen present in the litter is determined solely by the birds' diet. Every 1% increase in crude protein over basal metabolic needs increases ammonia excretion in litter by 7-10%. This number can be multiplied as consecutive flocks are placed on the built up litter. Then, the amount of ammonia driven from the litter to the air is

impacted by temperature and surface area. High temperatures purge ammonia from the litter, but are necessary to maintain bird health and comfort. Surface area is the one variable producers can influence. The more surface area, the more ammonia is release from the litter; so minimizing surface area by decaking only–not tilling–will help lower ammonia released. Hong Li at the University of Delaware illustrated in his research that ammonia increased as the flock matured and by applying multiple applications of SBS during the flock ammonia levels and foot pad lesions reduced significantly.

Nighttime Ventilation

Recent research by Dr. Mike Czarick at the University of Georgia pointed out the impact of night time ventilation. Ammonia concentrations are generally proportional to ventilation rates. Air quality is traditionally evaluated during the day; if ammonia levels are acceptable the ventilation strategy remains unchanged. However, if ventilation at night is dictated by interval timers and not temperature, the ammonia concentrations will be twice as high at night than day. If the fans are only operating a third as much at night, ammonia concentrations can be three times as high (Fig. 2).

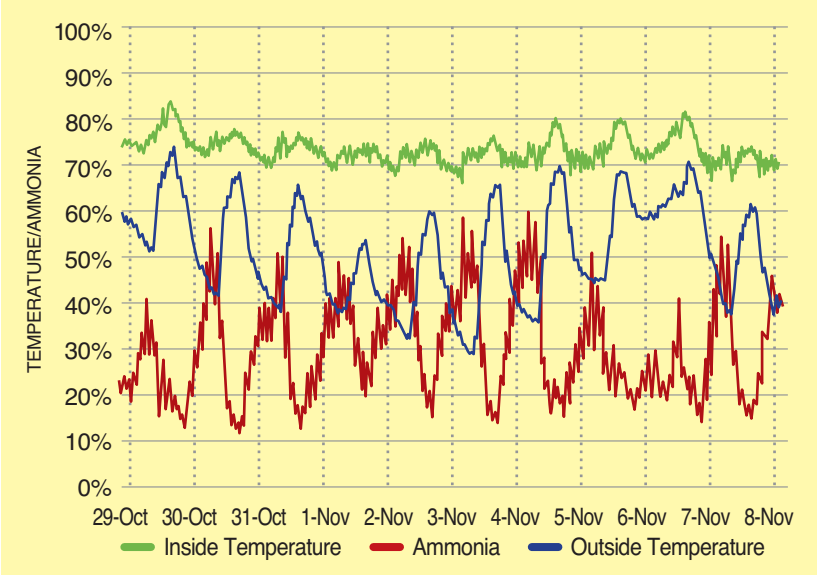


Figure 2. Inside/outside temperature and ammonia for a house with three week old birds.

Ventilation Management BMPs

Ventilation BMPs are just as critical as waterline BMPs. Constant re-education is necessary to ensure producers understand proper air movement and quality in all phasesof production. Ventilation will have the greatest impact on how much moisture is able to evaporate off the floor and be effectively removed from the environment. Dr. Mike Czarick at University of Georgia (Fig. 3) demonstrated that water consumption increases greatly throughout the flock. For every pound of feed consumed the bird will drink a quart of water. Only 20% of the water consumed will be retained for growth while the other 80% goes to the floor and the environment. On a flock of 24,000 birds, the total gallons consumed can be in upwards of 50,000+ gallons.

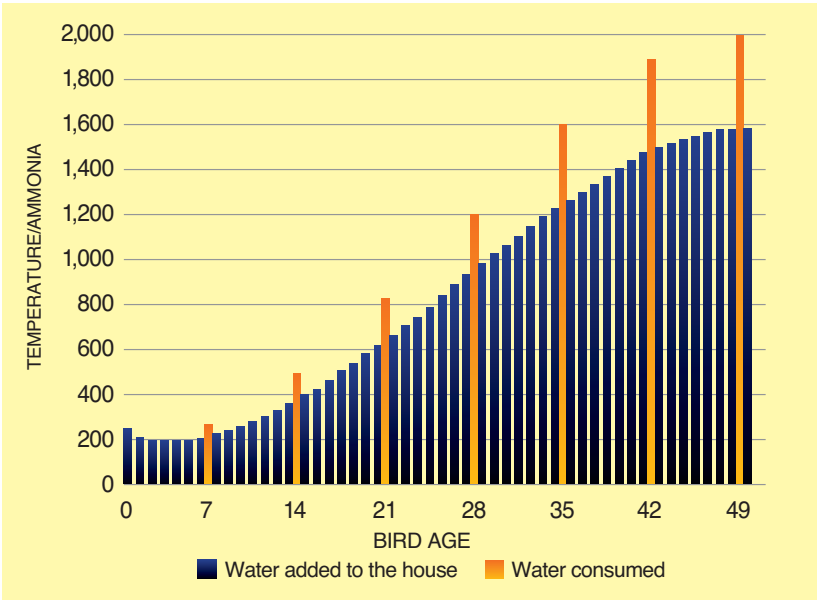


Figure 3. Bird water consumption

Open vent boxes and rotating fans give no indication of effective ventilation. To compound the problem, dirt on the blades, louvers and screens of the fans will create a deficit of air volume and moisture removal. A loss of more than 30% fan efficiency reduces air exchange and creates higher RH%. At that point, no matter how hard the producer tries to maintain a RH% of 50-70%, it will not be achieved making wet litter inevitable.

Impact of Litter Substrates on Paw Lesions

Growth in the poultry industry has created a challenge in the availability of litter materials and material diversification has ensued. Producers are currently utilizing a variety of substrates including pine shavings, sawdust, rice, oat and sunflower hulls, switch grass and chopped miscanthus grass among others. The impact of litter materials on bird health and performance is currently under review, and the results so far are consistent with what is already known about moisture.

Bedding has been found to influence the incidence of foot pad dermatitis and it was directly linked to litter moisture and caking. Bedding materials that result in drier litter will more than likely have fewer foot pad issues.

Litter Management BMPs

Using the proper amount of the right bedding material at the start is a critical component to the success or demise of a built up litter program. At any time throughout the growout cycle, litter conditions will tell a producer whether they are meeting their waterline and/or ventilation BMPs based on the surface conditions of the litter. If cake is forming on the sidewalls or at the fans, ventilation requirements are most likely not being met. If the cake or wetness forms under the drinker lines, the drinker system is being compromised. The result will be paw and health problems as liquid ammonia creates more volatized ammonia as the flock matures which will exasperate problems with paw lesions, respiratory distress and potential blindness.

It is vital for the industry to place top priority on litter and litter management–a practice that extends far beyond ensuring proper surface te mperature at placement. The litter drives everything in the facility: ventilation, temperature control, waterline and feed line management. It is a living, breathing entity within itself and how it is managed will determine its ecology which ultimately determines e the performance of each flock. The importance of paw quality and ammonia volatility goes beyond a paw grader at the processing plant. If the feet of the bird are sore and have open wounds, birds are less likely to eat and drink out of necessity. It is critical to not be one dimensional when it comes to air quality, paw quality and litter management.


SAFER CHOICE
Meets U.S. EPA Safer Product Standards
epa.gov/saferchoice
WHERE'S YOUR LITTER TREATMENT TAKING YOU?
If it's not consistent, safe and effective like PLT, you're just being taken for a fast ride.
There's little value in a product that only works under certain conditions–even less when it can be detrimental to your birds. PLT®-Poultry Litter Treatment is the only product that:
• Pulls moisture from the air and litter so activation happens in any conditions–wet or dry
• Effectively lowers pH for an extended period to create a more favorable litter ecology for birds which discourages harmful microflora
• Is non-hazardous and can be safely applied for ammonia and pH control any time birds are in production
You'll never get watered down performance. PLT–always safe and effective.
JH Ag
WE KNOW pH MATTERS
www.JonesHamiltonAg.com

PWT is now

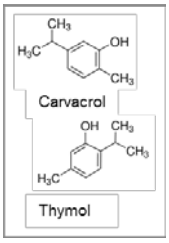
pH Safe

Same product from Jones-Hamilton Co.
is now available from BVS as **pH Safe**

pH Safe water acidifier is the first FDA-approved feed grade inorganic acid water treatment available to the poultry and livestock industries. Due to the unique chemistry of **pH Safe**, the consumption of treated water does not decrease at higher concentrations, as has been reported for organic acids. **pH Safe** contains the strongest animal feed grade mineral acid available. A much lower addition rate is required to acidify drinking water to biologically effective low pH levels. This lower addition rate provides pH reduction with no bitter taste. Birds won't back off from **pH Safe** treated water, so optimum water consumption is maintained. This advantage gives producers the flexibility for administration in a wide range of application in all livestock and poultry species.

Oregano Essential Oil: Poultry Production The Natural Way

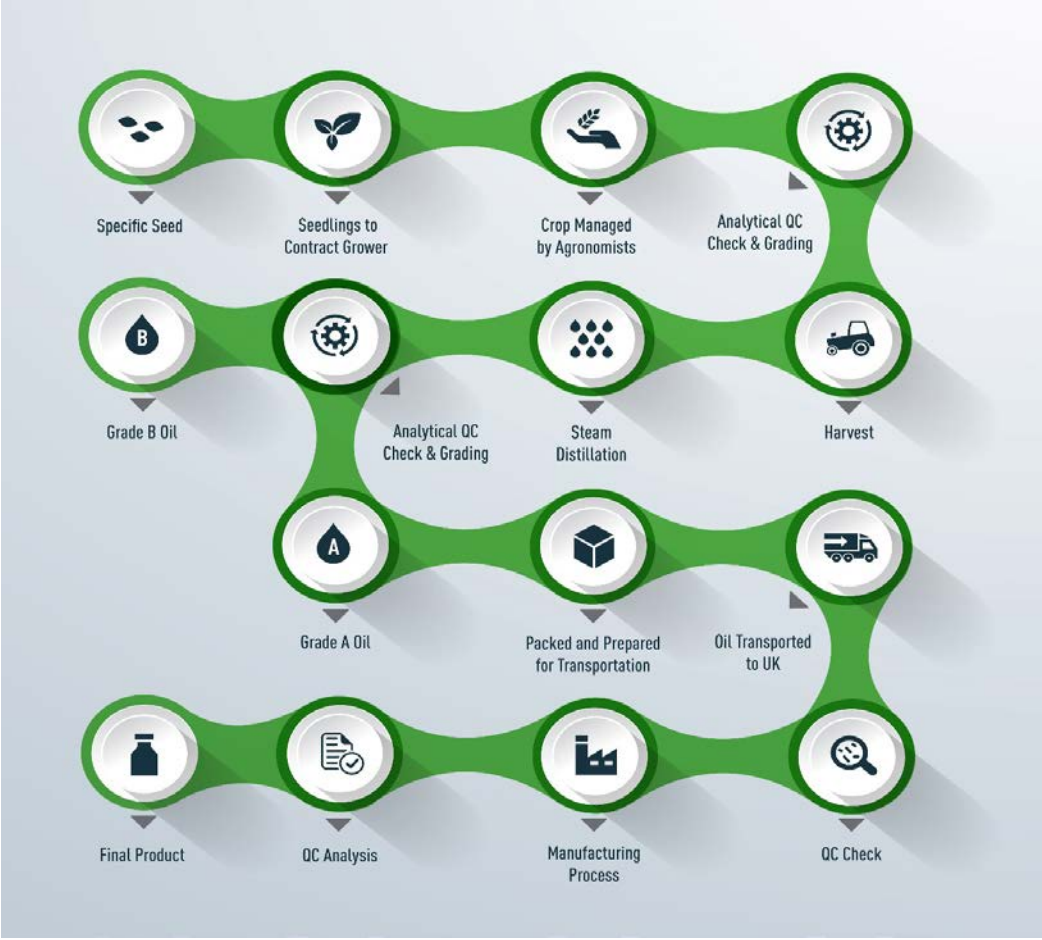
Herbs and their extracts, including essential oils, have been used as natural treatments for a range of ailments for centuries. The use of essential oils such as oregano, to help manage intestinal health in livestock is gaining momentum. Intestinal stress, such as enteritis or coccidiosis, can upset the balance of intestinal microbiota and adversly impact animal production. In a world of increasing scrutiny of antibiotic use and demands on the farmer, anything that can be done to help restore intestinal microbiota balance naturally, needs to be considered.



Oregano oil comprises a range of compounds but it is the phenols carvacol and thymol, and their ratio that are the most important and give the oil its range of properties. Differences in season, quality of soil, plant species and extraction method can all affect oil properties and therefore the consistency of the final product. Anpario have managed to eliminate this variability in the production of Orego-Stim.

Orego-Stim (OS) is a 100% natural product based on *Oregano vulgaris,* grown organically in the hills of Europe. Developed by an agronomist specifically for Orego-Stim, the oregano plant has a high yield of Thymol and Carvacrol in the ratio needed.

Orego-Stim production



From the point of harvest through to the final product, multiple quality checks are performed. Upon arrival at the distillery, the harvested oregano is tested to determine the levels of Carvacrol and Thymol and then transferred to the tanks for steam distillation. Following distillation, the extracted oil is tested again to measure the levels of Carvacrol and Thymol. If the levels do not meet specification, the oil is redistilled until the specification is met.

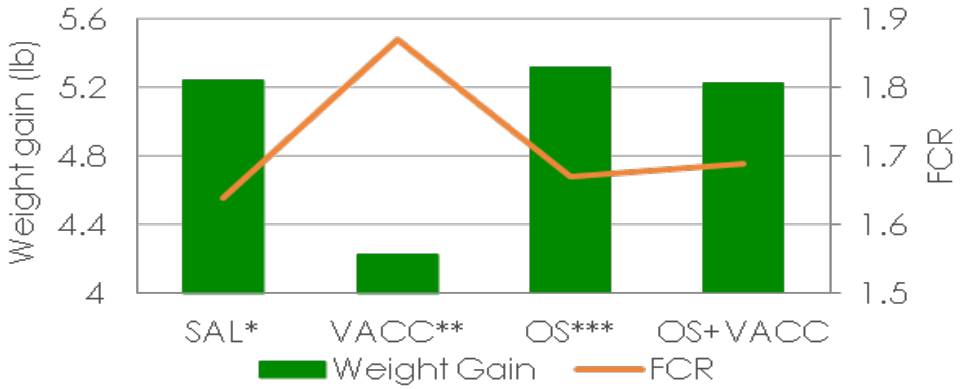
The oil is then shipped to the UK production plant where the oil is blended with the carrier. The final stages of production are performed in accordance with ISO9001. ISO9001 is a certified quality management system, designed to ensure products and services consistently meet the customers' needs.

The Benefits of Orego-Stim

Reaching growth potential

Orego-Stim stimulates the bird's sense of appetite, increasing feed intake. With an increase in appetite, the production of digestive enzymes increase, improving digestion and nutrient utilisation and allowing the bird to perform to its potential. By stimulating appetite, OS is even able to support the bird to reach its genetic potential during periods of intestinal stress.

Orego-Stim increases appetite and digestion helping birds perform closer to ther potential

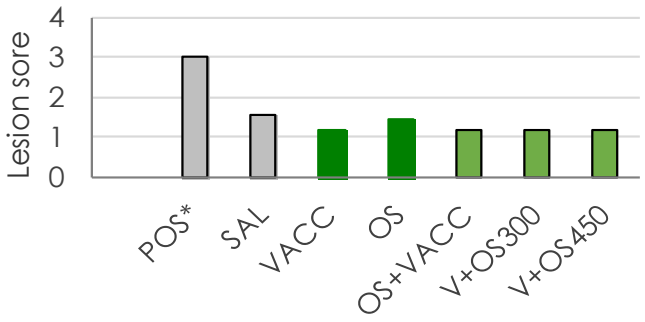


* Salinomycin ** Vaccine*** Orego-Stim

Helping birds cope with intestinal stress

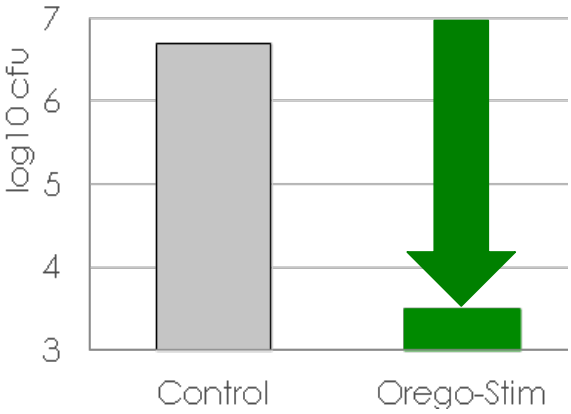
Orego-Stim can also help birds to cope with intestinal stress. For example, coccidial infection or vaccination can often damage the gut and lead to an imbalance in the gut microbiota such as an overgrowth of *Clostridium perfringens*. The optimal ratio of Carvacrol and Thymol helps restore this balance and lessen the impact on the gut

Average score of intestinal damage following Eimeria infection



* Positive (Challenge) control

Reduced C. *perfringens* counts at 31 days



What does this mean?

This means that poultry producers can be confident that their investment will see a return because quality and consistency is ensured through the rigorous checks.

Orego-Stim is produced in both liquid and powder form offering flexibility to both feed mill and farmer. This means Orego-Stim can be used throughout the bird production cycle or at those times when the properties of Oregano are really needed.

100% Natural Feed & Water Additive

OREGO-STIM™

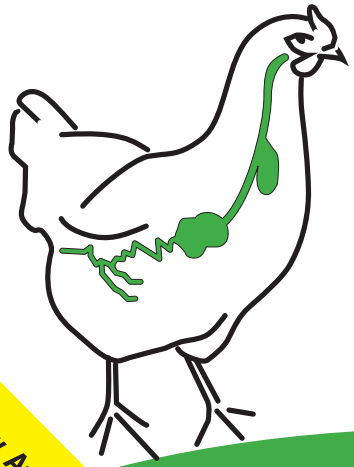
- Premium oregano oil
- Consistent quality
- Innovative packaging
- Available in liquid and powder form
- Low inclusion in feed and water
- Rigorous quality checks throughout production guarantee consistent quality

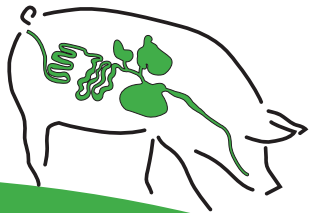
QUALITY ASSURED

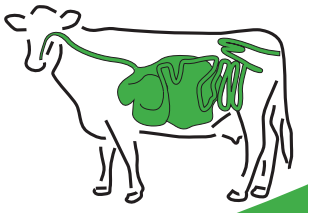
Contact your BVS sales person to find out how Orego-Stim™ can benefit your business

1-888-378-4045

www.orego-stim.us







Now Available in the US

ANPARIO
Enhancing nature through science™

QMS ISO 9001 REGISTERED

Gil Bio Bleach

Long-Lasting Stabilized Chlorine • Effective for up to 2 Weeks

pH-buffered for enhanced efficacy

\Does not provide a source for bacterial growth greatly
Reduces cross-contamination potential

Does not Freeze nor Evaporate

TRUE PAN POWDER
Ultra-dry, fine composition resists moisture clumping while providing superior foot coverage

Effective Cleaning, Bleaching and Deodorizing Properties

Economical way to clean footwear

Ready-To-Use;
NO MIXING

Available in
11, 35, 50, 100
and 400 pound
Re-Sealable
Containers

DIRECTIONS

- Add as needed to foot pan to maintain a half-inch layer. (A thicker layer will not increase effectiveness.)
- Remove organic contaminates as necessary.
- Change out pan powder every 2 weeks for optimal results.

Gil Io-Poult & Gil Medic-Dyne

Multi-Purpose Iodine Supplement

Gil Io-Poult: 1.75% titratable iodine
Gil Medic-Dyne: 3.5% titratable iodine

Cold Weather Stable

Concentrate mixes readily in cold, hard water

Provides Essential Iodine to Poultry

Cleans and conditions water drinking systems, keeping them free of slime and mineral scale

Effective Deodorizer

Consult your local sales or service representative for use directions.

Available in 1, 5, 15, 55 and 275 Gallon Containers

Gilmer Industries has been manufacturing top-quality cleaners and disinfectants for over 40 years.

GILMER INDUSTRIES, INC. *Products that Perform*

560 Stone Spring Road
Harrisonburg, VA 22801

PO Box 1247
Harrisonburg, VA 22803

phone 800/200-4162
info@gilmerindustries.com

ProOxine®(AH) Disinfecting Solution

For Animal Drinking Water

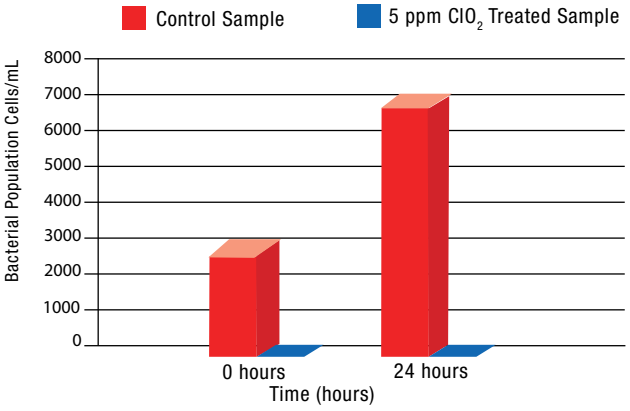
ProOxine® is the most effective tool for water management in animal facilities. ProOxine® keeps the bacteria level down in the water lines, and prevents biofilm from developing thus keeping the animals healthier by keeping down the pathogen level that could potentially travel from one animal to another. ProOxine® makes drinking water more palatable to poultry and livestock and therefore they drink more. Additionally, ProOxine® is highly effective in keeping water systems free of build up.

AANE (Automated Activation Non-Electric) System

Efficacy of ProOxine® against Biofilm

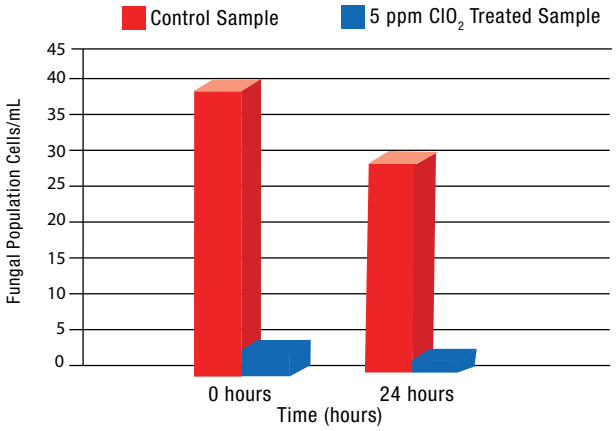
CONTROL EFFECT OF 5 ppm ClO_2 AGAINST BIOFILM BACTERIA

On Bacteria	Control Sample	5 ppm ClO_2 Treated Sample
0 Hour	3000	30
24 Hours	7000	2



CONTROL EFFECT OF 5 ppm ClO_2 AGAINST BIOFILM FUNGI

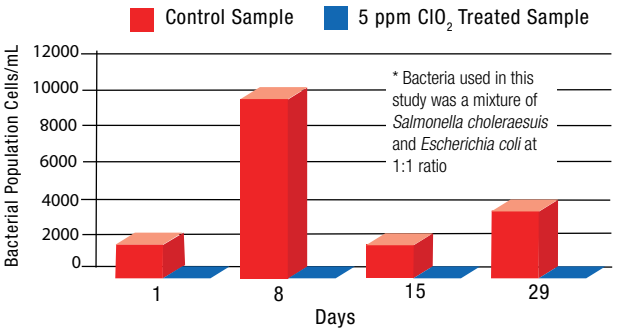
On Fungi	Control Sample	5 ppm ClO_2 Treated Sample
0 Hour	40	4
24 Hours	30	2



Efficacy of ProOxine® against Salmonella and E-coli

REDUCTION OF BACTERIAL POPULATION* IN WATER AFTER CONTACT WITH 5 ppm CHLORINE DIOXIDE

On Bacteria	Control Sample	5 ppm ClO_2 Treated Sample
1 Day	2000	20
8 Days	10000	2
15 Days	2000	2
29 Days	4000	2



Bio-Cide INTERNATIONAL

Exceptional Chemistry • Extraordinary People • Excellent Service
www.bio-cide.com • 2650 Venture Drive, Norman, OK 73069
405.329.5556 • 405.329.2681 fax • 800.323.1398
Bio-Cide International is ISO 9001:2000 certified

BVS BEST VETERINARY SOLUTIONS, INC.

Distributed by:
Best Veterinary Solutions, Inc.
515-836-4001 • 888-378-4045
www.bestvetsolutions.com

Pure *Yucca schidigera* powder

BIOSUPREME®

ORGANIC FEED INGREDIENT

ENHANCES FEED EFFICIENCY

BIOSUPREME® contains saponins (active ingredient), which have surfactant properties, playing an important role in animal nutrition. The glycocomponents within saponins have a natural affinity to bind ammonia and other noxious gases, therefore improving the environmental air quality within the poultry houses, swine barns, and other livestock commercial facilities.

REDUCES THE NEGATIVE EFFECT OF AMMONIA

BIOSUPREME® is produced under strict certified Food Safety Management System guidelines as well as certified organic manufacturing process. We use only mature and over mature *Yucca schidigera* plant stems obtained under an environmentally conscience sustainable harvesting program, monitored by our own in-house forestry engineers.

BIOSUPREME® L

Available in concentrated liquid, which can be included in drinking water systems.

GMP+ Feed Safety Assurance

SGS Feed

SGS ISO 22000

SGS HACCP

products available OMRI LISTED Para Producción Orgánica For Organic Use

AGROIN BAJA AGRO INTERNATIONAL

Ensenada, Baja California, México
www.yucca.com.mx

BVS

Distributed in the United States by:
Best Veterinary Solutions, Inc.
325 Lakeland DR., N.E. Willmar, MN 56201
Toll Free: 1-888-378-4045
www.bestvetsolutions.com

BAI-AN-BSP-EN-01

Huvepharma® Water Solubles

HUVEPHARMA®

Huvepharma is excited about the addition of our new water soluble products:

Chloronex®
(Chlortetracycline HCl)

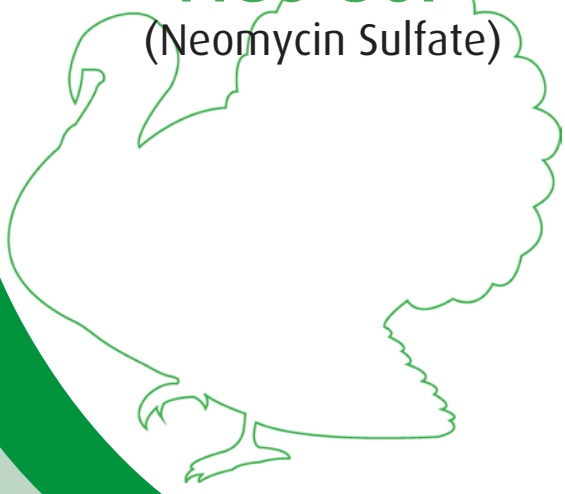
Oxytet Soluble®
(Oxytetracycline HCl)

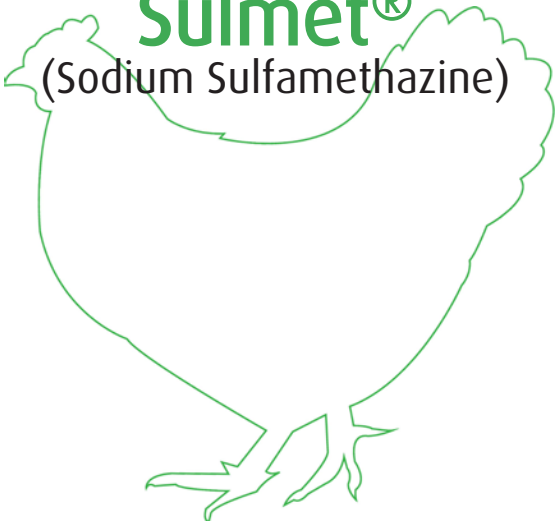
Lincomycin
(Lincomycin HCl)

R-Pen®
(Penicillin G Potassium)

Neo-Sol®
(Neomycin Sulfate)

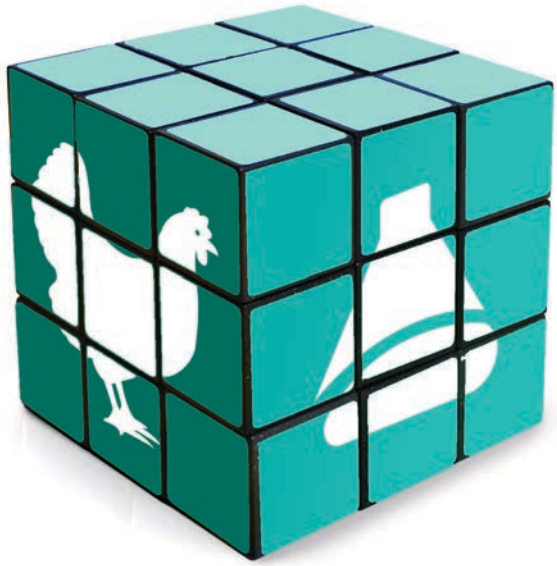
Sulmet®
(Sodium Sulfamethazine)





Huvepharma, Inc. • 525 Westpark Drive, Suite 230 • Peachtree City, GA 30269
Phone: 770-486-7212; Fax: 770-486-7217
Customer Service: 877-994-4883
email: customerservice@huvepharma.us • www.huvepharma.com

MERIAL
CUSTOM VACCINES



CUSTOM SOLUTIONS FOR YOUR COMPLEX NEEDS.

Your production complex has unique needs. That's why we work closely with you to better understand these needs. We'll develop an optimum strategy and a custom vaccine solution that promotes your flock's health. And as new challenges emerge, we'll continue to work with you to look for new solutions. Partnering with you on this journey is our commitment to you.

avian.merial.us

MERIAL
A SANOFI COMPANY

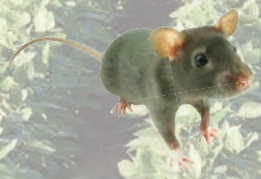
CONTROL RODENTS & EARN A YETI®

WITH QUALIFYING PURCHASE
OFFER GOOD SEP 1 - NOV 30, 2016

NEW FOR 2016

YETI Hopper 20 Bag Cooler:

Purchase (80) pails of 16 lb. FastDraw or Revolver Soft Bait,or 20 lb. BootHill or Hombre Mini Blocks.



Qualifying rodenticides may be mixed or matched to achieve a qualifying purchase quantity.

Is this your first time using Liphatech products? (y/n) _____

What brands do you currently use in your rodenticide rotation? _____

NAME: _____

COMPANY: _____

ADDRESS: _____

CITY: _____ STATE: _____ ZIP: _____

PHONE: _____ EMAIL: _____

LIPHATECH

Applies to end-users only; distributors & resellers do not qualify.

Offer good on purchases made:

Sep 1 through Nov 30, 2016
Please allow 4-6 weeks for processing.

Qualifying Liphatech Rodenticides:

16 lb. FastDraw or Revolver Soft Bait pails and 20 lb. BootHill or Hombre Mini Block pails.

Qualifying end-user purchase must be on one (1) invoice.

Qualifying rodenticides may be mixed or matched to achieve a qualifying purchase quantity of 80 pails.

Please mail completed coupon with original invoice to:

Liphatech - YETI Giveaway
3600 W. Elm Street
Milwaukee, WI 53209

Must be postmarked by Dec 16th, 2016.

CLEANOUT WITH CANNON GIVEAWAY

NEW!

CONTROL RODENTS & EARN A YETI OR TRAIL CAMERA

WITH QUALIFYING PURCHASE
OFFER GOOD SEP 1 - DEC 31, 2016

CANNON™
SOFT BAIT

4 lb. BAG

Purchase 2 cases of Cannon Soft Bait, (8) 4 lb. bags, and earn your choice of a:

YETI 20 oz. Rambler Tumbler or
Moultrie A-20 12 Megapixel Trail Camera

- Worlds first Bromethalin Soft Bait
- Kills rodents in 24-48 hours
- Excellent control of mice & rats
- Use between flocks during cleanout periods
- One-step control, no more mixing 2 products
- Packaged in 4 lb. bags, 4 bags/case

Scan to learn more:

Please send me: ☐ Moultrie 12MP Trail Camera ☐ YETI Rambler 20 Tumbler

What brands do you currently use in your rodenticide rotation? _____

NAME: _____

COMPANY: _____

ADDRESS: _____

CITY: _____ STATE: _____ ZIP: _____

PHONE: _____ EMAIL: _____

LIPHATECH®

*** Not registered for sale or use in California**

Applies to end-users only; distributors & resellers do not qualify.

Offer good on purchases made: Sep. 1 through Dec 31, 2016

Please allow 4-6 weeks for processing.

Qualifying Liphatech Rodenticides: Cannon Soft Bait 4 lb. Bag

Qualifying end-user purchases must be on one invoice.

Please mail completed coupon with original invoice to:

Liphatech – Cannon Giveaway
3600 W. Elm Street
Milwaukee, WI 53209

Must be postmarked by Jan 16, 2017.

BVS
Best Veterinary Solutions, Inc.
325 Lakeland Drive NE
P.O. Box 266
Willmar, MN 56201

RETURN SERVICE REQUESTED

Barnes Paper

- ✓ "A" & "B" Flute Brooder Guard Feed Paper
- ✓ 12" Water Line Paper
- ✓ Jumbo Corrugated Feed Lids
- ✓ Disposable Feed Lids
- ✓ Red & Gray Plastic Feed Lids
- ✓ Egg Cases and Egg Flats