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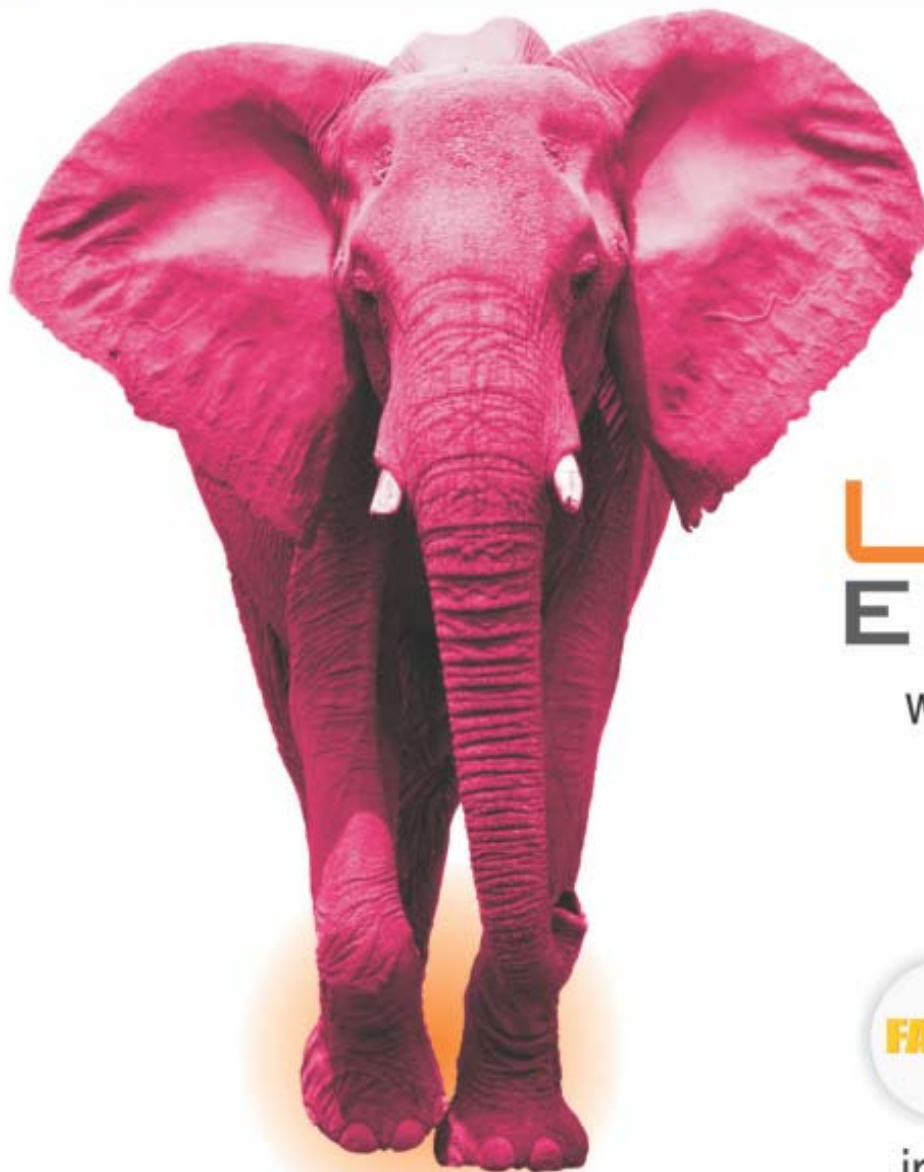
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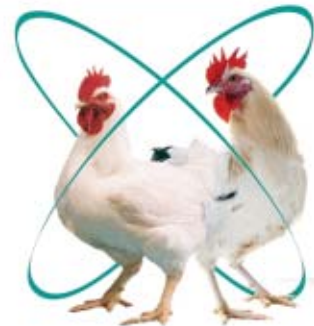
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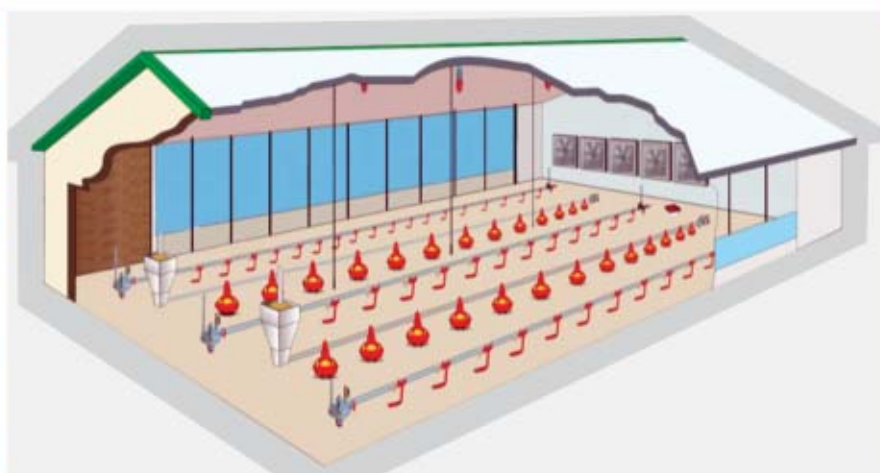
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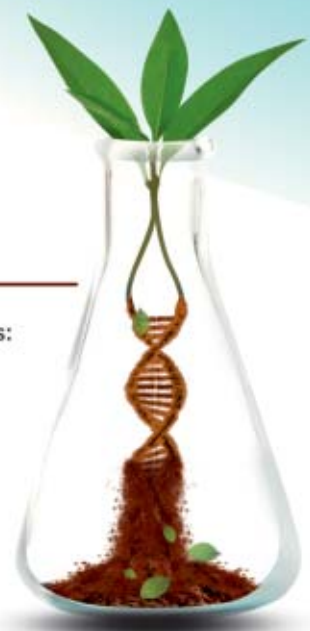
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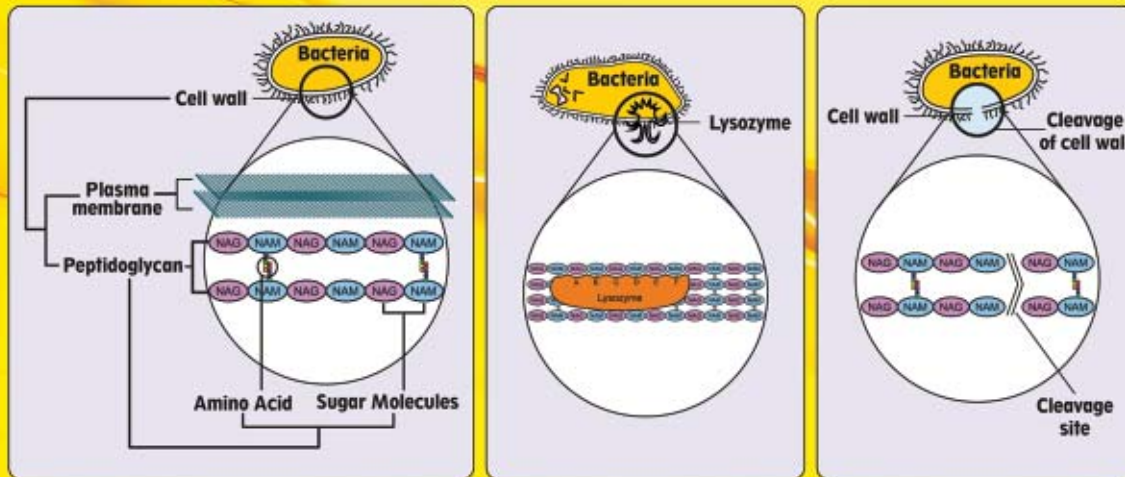


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# Designer Egg: A Nutritional Approach: A Review

M. D. Jadhav, M. Choubey, V. R. Patel, S. Pradhan, K. K. Sorathiya

Department of Animal Nutrition

College of Veterinary Science and Animal Husbandry, Navsari Agricultural University, Navsari.

**Abstract:** Egg is nutritious and nature's original functional food. Provide high biological value protein with minimum cost. In spite of these good qualities of egg it is always blamed due to high cholesterol which affects the consumption of it in health-conscious people. So that it comes to modifying the eggs so far as level of cholesterol. There are so many methods which affect the cholesterol level in the egg yolk.

**Introduction:** Egg is considered as a natural life supporting chemical storehouse which provides highly nutritious food with biological packaging (egg shell) without any chance of adulteration. It is blessed with all the essential nutrients which can nourish an embryo to a chick. Eggs have been described as "Nature's original functional food" (Hasler *et al.*, 2000). They are being used worldwide as food due to its protein quality (high biological value), low cost and palatability. In spite of all positives, it is being often blamed as high cholesterol food because of its lipid profile in the yolk. Due to this a cholesterol phobia has been raised among the health-conscious populations, which leads to a declining trend in egg consumption throughout the globe especially in western countries (FAO, 2003). Not only this, the world famous weekly magazine 'Time' has devoted one of its issues covering cholesterol phobia as a lead topic to make the larger population aware of it (Wallis, 1984). In the backdrop of above facts, the concept of "Designer Egg" has been evolved with aim to minimize the health-negative nutrients (*viz.* cholesterol and triglycerides) and enriching it with health-positive nutrients *viz.*  $\omega$ -3 fatty acids and antioxidants, vitamins and minerals (Ankari, 1998).

## Effects of High Cholesterol:

- Too much cholesterol can build up in arteries over time.
- Leads to Atherosclerosis in vital arteries.
- Cause heart attacks and strokes.
- A major constituent of gallstone.

## How to Design the Egg/Methods of Designing the Egg:

A designer egg may be characterized by an egg whose nutrient contents have been altered from the standard one in terms of essential fatty acids, cholesterol, vitamins, minerals, antioxidants etc (Sim, 1998). Simply they can be expressed as 'Nutritionally enhanced, Value added, Supplemental eggs'. A typical designer egg may have cholesterol level reduced up to 40% and omega-3 fatty acids increased by 6 times as in regular egg (USDA, Nutrient Database, 2011). As per Narhari (2006) egg is a best vehicle to incorporate several health-promoting components in it, therefore possibilities for designer egg are limitless. Such an alteration of various nutrients in an egg could be easily achieved by nutritional manipulation of the laying hens' ration (Singh, and Sachan, 2010).

**Low Cholesterol Designer Egg:** They can be produced by using different supplements in the laying hens' ration.

**Supplementation of Chromium:** The main constraint of egg *i.e.* cholesterol can be easily manipulated by supplementation of chromium. By supplementing chromium from 250-1000 ppb at the interval of 250 ppb in different groups will significantly decrease the egg cholesterol along with yolk cholesterol (Yildiz *et al.*, 2004). On the basis of same line Parlat *et al.*, 2002 and Sahin *et al.*, 2001 supplementing the chromium in the poultry diet and observe to reduce the yolk and plasma cholesterol beneficially in contrast to the control group.

**Supplementation of Copper:** another way of reducing the cholesterol concentration in yolk by supplementation of copper. Addition of different amounts of Cu to the ration of laying hens resulted in decreased yolk cholesterol and blood cholesterol (Ankari *et al.*, 1998). Dietary Copper at 100 & 150 ppm in diet reduces both plasma and yolk cholesterol in laying hens and quails (Taneja *et al.*,

2006). Supplementing the copper upto 300 mg/kg feed in the diet of poultry will help in reduction of yolk cholesterol along with plasma cholesterol (Olgun *et al.* 2013).

**Supplementation of Probiotics:** “Microbial feed additive that have a beneficial effect on the health and well being of the host” (Fuller, 1993). Effect of probiotic is mediated via improved nutrient utilization, Digestive enzyme secretion, Appetite stimulation, Optimization of gut health, Immune modulation. (Toms and Powrie, 2001). Also help increase in daily feed consumption and nitrogen and Ca retention (Nahashon *et al.*, 1996).

Using multi-strain of Probiotic 0.5g/kg of feed supplementation in laying hen diet will lead to increase the Egg production and decrease the yolk cholesterol significantly (Khan *et al.*, 2011). On the basis of same line supplementing the probiotics (*Rhodobacter capsulatus*) in layers ration at different rate from 0.01 to 0.04% will also decrease the yolk cholesterol along with yolk triglycerides (Salma *et al.*, 2007).

**Supplementation of Herbals:** Supplementation of Garlic to laying hen for over 16 week at different levels from 0 to 10 % in their diet will significantly lowers the serum as well as yolk cholesterol (Chowdhury *et al.* 2002). Yalcin *et al.* 2007 Supplementing Garlic Powder in layers rations which gives positive effect on the reduction of Blood Serum Cholesterol level in 300 layers for 21 weeks. They also show the supplementing the PUFA in diet of layers will gives reduction of cholesterol level in layer diet in diet of layers.

#### **Ω-3 Enriched Designer Egg:**

As Ω-3 fatty acids cannot be synthesized in human body and are supposed to carry out a number of vital functions including regulation of blood lipid profile and inflammatory response with immune-modulation (Yashodhara *et al.*, 2009). Having different functions as prevents the cardiovascular disorders, Lowers the circulating cholesterol, Suppresses the inflammatory process, Regulates the triglyceride, LDL and HDL, and Enhances immune system. Different dietary sources Fish and Fish oils- Cold-water fish such as salmon, mackerel, menhaden, halibut, and herring, Plants-

Flax seed (Linseed), Soyabean, Walnut, and Oils - from Canola, Safflower and vegetable oils and Marine algae.

Among all the sources flaxseed oil is the richest source followed by fish and soybean oil. Supplementation of flaxseed oil at different levels from 0%, 1.5% and 3 % (Yalcyn *et al.*, 2007) and fish oil at the rate of 0%, 2%, 3% and 4% (Maurice, 1994) as source of omega-3 fatty acids at the varying levels in the diet of layer bird resulted in eggs enriched with important Ω-3 fatty acids (ALA, EPA and DHA) significantly.

#### **Antioxidant Enriched Designer Eggs:**

In today's lifestyle everyone has to experience a lot of stress. These stresses are mediated via oxidative processes which generate a lot of free radicals and peroxides inside the body. Dietary antioxidants are the best counter for such stresses. Designing the eggs with higher content of antioxidant is an added way out. Egg naturally contains antioxidant substances like Vitamin E, Vitamin A, and Selenium etc. But their levels are not sufficient to protect Designer eggs rich in omega-3 fatty acids

Supplementation of vitamin E or fish oil (as source of Vitamin E) in the ration of layers led to a linearly increase in content of α-Tocopherol in a dose dependent manner (Meluzzi, *et al.*, 2000). Vitamin E supplementation not only increased the content of α-Tocopherol but also maintained the higher concentration of Ω-3 fatty acids in yolk similar to those of fresh egg (Meluzzi, *et al.*, 2000). This has led to better shelf life and keeping quality of egg also over a period of 4 weeks (Meluzzi, *et al.*, 2000).

Such egg are now gaining momentum in the global market under different trade names, however Indian market is more encouraging in metro cities and Southern part due to higher number of nonvegetarian and health cautious population. Nonetheless, increasing health awareness and purchasing power of masses is a hope for growth of its market.

#### **Conclusion**

Being the best source of all the vital nutrients, high cholesterol content is the major constraint for egg consumers. By designing the egg to incorporate

several health promoting components, it could be the finest vehicle of nutrients from animal to man. Nutritional interventions like supplementation of chromium, copper, herbs, probiotics,  $\omega$ -3 fatty acids, antioxidants etc. seems to promising candidate for this purpose. Demand of such eggs in the market is gaining momentum which is expected to be on rise in coming future. Viewing its need more research should be undertaken in this area for future scope.

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# Nutritive Value of Chicken Egg

Dr. Akshay R. Bariya<sup>1</sup>, Dr. Ajay S. Patel<sup>1</sup> and Dr. G. P. Sabapara<sup>2</sup>

<sup>1</sup>Assistant Professor, <sup>2</sup>Associate Professor- Department of Livestock Products Technology, CoVSc & AH, JAU, Junagadh- 362001

Eggs are considered a delicacy and recognized as an important protective food from ancient times. Eggs are rich in easily digested fat, high-quality protein, are a good source of vitamins, and a valuable source of minerals. Eggs are palatable and useful in special diets and indispensable in cookery practices. Egg proteins consist of an ideal balance of nutritionally indispensable amino acids. The hen egg is, thus, useful as a supplement to those foods in which essential amino acids are in low concentration or absent. Eggs are suitable for nutritional enhancement as well as improve some properties of several kinds of foods.

## Protein:

Egg proteins, which are distributed in both yolk and albumen, are nutritionally complete proteins with a great balance of amino acids. The nutritional value of protein depends upon its amino acid composition and proportion. The value of the whole egg protein is considered to be 100. According to the World Health Organization, egg protein has the highest true digestibility among major food proteins. Due to its high quality, egg proteins are used as a standard for measuring the nutritional quality of other food proteins. The protein content of two eggs

## Role of an egg as a good nutrient

	Recommended daily allowance for a moderately active man	Quantity in two eggs	% of daily requirement supplied by two eggs
Energy, Calories	3000	180	6
Proteins, gms	70.0	12.2 – 14.0	25
Fat, gms	50.0	11.0	22
Carbohydrate, gms	570.0	-	-
Calcium, gms	0.8	0.06	8
Phosphorus, gms	0.9	0.24	30
Iron, mg	12.0	3.20	26
Iodine, mg	0.1	0.01	10
Vitamin A, I.U.	5000	1000 – 1500	20 – 30
Vitamin D, I.U	400	100	25
Vitamin C, mg.	75.0	-	-
Vitamin B-1, mg.	1.5	0.12	8
Vitamin B-2, mg.	2.0	0.32	16
Niacin, mg	20.0	1.20	6



is about 12 g which provides 25 % daily protein requirement of an adult man. Egg protein supplies the essential amino acids which cannot be produced or synthesized by the human body.

In the egg all the essential amino acids are present which are essential to man, they are

- |               |                   |
|---------------|-------------------|
| 1. Tryptophan | 6. Leucine        |
| 2. Threonine  | 7. Isoleucine     |
| 3. Histadine  | 8. Methionine     |
| 4. Arginine   | 9. Valine         |
| 5. Lysine     | 10. Phenylalanine |

Egg protein having excellent supplementary value. For example, cereal proteins is poor in lysine, the protein of pulses and oilseed are poor in cysteine (sulfur-containing a. acid). Hence a combination of these cereals, pulses, and oilseed may fulfill the deficiency of particular amino acids. The egg proteins are easily digested and its biological value is high as compared to meat proteins. Eggs do not have fiber. Dietary fiber is supposed to eliminate

carcinogens from the intestines. Thus, some people say eggs are responsible for colon cancer, but it is not proved that eggs alone can cause colon cancer. The table below gives daily requirements of amino acids in man's diet which can be met by including 2 eggs in the diet. An egg has an excellent nutritive value and it supplies the following nutrients in the diet.

**Carbohydrates:**

Most of the egg carbohydrates are present in the albumen. The content of carbohydrates in the hen egg is only about 0.5-1.0% of the whole egg on a wet basis. Thus this nutrient cannot be considered as a source of energy. Carbohydrate present in egg reacts with egg protein during cooking causing milliard browning reaction specifically in the manufacture of egg powder. The browning action is prevented by enzymatic action (glucose-oxidase), bacterial fermentation (*Aerobacter aerogenus*), and yeast fermentation (*Saccharomyces cerevisiae*).

**Lipids:**

The lipid content in the egg is 11.87 percent of total egg content. Hen egg provides five to six gram of easily digestible fat, wherein most desired unsaturated fatty acids (especially oleic acid) is more as compared to other livestock products. The fat in the egg is found almost in the yolk and only less than 0.05 % in the albumin. Total fatty acid composition in the form of monounsaturated (appr. 47 %) about a further 18 % and polyunsaturated and only 34 % is saturated. The most abundant fatty acids in the egg are palmitic, oleic, and linoleic acid. Phosphatidylcholine present in egg yolk is a significant source of choline, which is an important nutrient in brain development, liver function, and cancer prevention. Types of lipids are phospholipids 32.8 percent, sterols 4.9 percent, and neutral fats 62.3 percent (total 100 percent).

**Cholesterol:**

Cholesterol content has been reported to be 274 mg/egg, recent studies 210 to 220 mg/egg, and 90% of cholesterol is in non-esterified form.

**Biological value and protein efficiency ratio**

	Digestibility	Biological value	Protein efficiency ratio
Egg	98	96	4.0
Milk	95.6	93.4	2.0
Beef	98	84	3.8
Mutton	98	78	3.2
Pork	98	76	3.2
Chicken	98	80	3.3
Freshwater fish	97	88.5	2.0
Seawater fish	85	81.5	-
Rice	96.5	85.1	2.0
Wheat	93	68.0	1.8
Jowar	91.4	83.1	2.0

Cholesterol is an important metabolite required for growth of the embryo, it is an integral part of cell membranes, and has an important role in nervous tissue development, besides synthesis of steroid hormones. An egg supplies about 0.72 g of (PUFA) polyunsaturated fatty acids, which includes 0.62 g of linolic acid. Yolk fat is predominantly of concentrated type. The recommended poly unsaturated/saturated ratio in any foodstuff 0.32 to 0.4 and in yolk, the ratio is 0.59, which is highly desirable. Mixed diets contain 450 mg of cholesterol per day. There will be no significant increase in cholesterol at the rate of 1 or 2 eggs in the diet.

**Vitamins:** Most egg vitamins, especially the fat-soluble vitamins, are contained in the yolk. Hen egg is considered a source of most vitamins necessary for human nutrition, except vitamin C. As a source of vitamin D, eggs rank second to fish liver oils. Eggs are low in Calcium (present in shell) and have no vitamin C. Chicks don't require vitamin C for their growth. An egg is a good source of all the B vitamins. It is a particularly rich source of vitamin

Vitamins	Content	RDA(%)
A – IU	590	11.8
B – IU	25	6.3
E – Mg	1	3.3
B1 – Mg	0.047	3.2
B2 – Mg	0.170	10.0
Niacine – mg	0.047	0.3
B6 – mg	0.073	7.3
Choline – mg	437	Not required
Pantothenic acid–mg	0.729	7.2
Folic acid – mcg	16	4.0
Biotin – mcg	9.70	7.4
B12 – mcg	0.57	9.2

B<sub>12</sub> and riboflavin. One egg may supply almost 12 % vitamin A, more than 6% of vitamin D, 9% riboflavin, and 8% pantothenic acid of the recommended daily allowance.

#### **Minerals:**

Egg contains many minerals that are required by the human body. Egg is an excellent source of iodine and phosphorus that are required for thyroid hormone and bone health respectively. Egg is also a rich source of biologically available zinc that is needed for the proper functioning of the immune system. Selenium from eggs serves as an antioxidant. Significant amounts of iron are present in the yolk but are bounded with phosvitin. Therefore the low bioavailability of the iron present in egg yolk is due to its tight binding to phosvitin and the formation of an insoluble phosvitin-iron complex. Calcium, a critical mineral needed for the body but it is largely concentrated in the eggshell with only minor concentrations deposited in the egg yolk. Eggs are not important in meeting the RDA for calcium and magnesium.

Minerals	Whole egg (mg)
Ca	28
Fe	1.04
Mg	6
P	90
K	65
Na	69
Zn	0.72

Due to low caloric value and easy digestibility, an egg is included in the diet of older people. Egg protein and emulsified egg fat – (egg yolk) are most suitable for babies and growing children. Eggs find a place in all diets including infertile eggs for vegetarian people.

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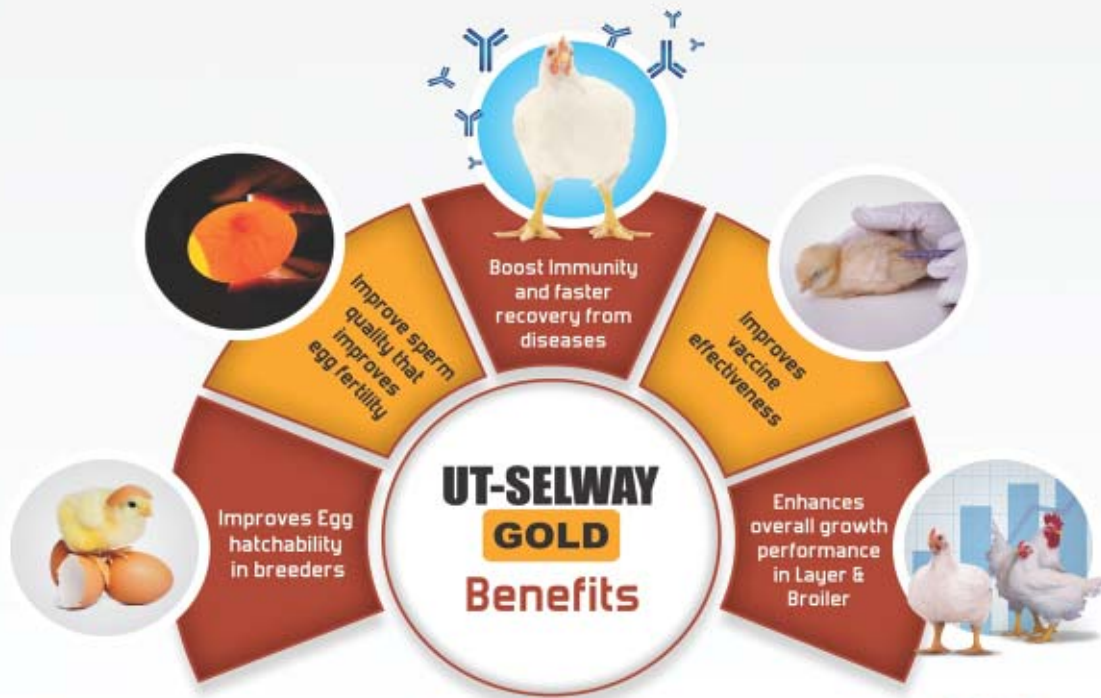
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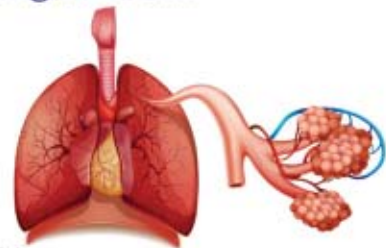
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# ***Ascaridiagalli* infection in chicken - an overview**

**Devina Sharma<sup>1</sup>, Kanika Sharma<sup>1</sup> and S. K. Khurana<sup>2</sup>**

<sup>1</sup> Department of Veterinary Parasitology, <sup>2</sup>Department of Veterinary Public Health and Epidemiology, DGCN College of Veterinary & Animal Sciences, Chaudhary Sarvan Kumar Himachal Pradesh KrishiVishvaVidyalaya, Palampur, Himachal Pradesh (176062)

## **Introduction**

Poultry is one of the fastest growing segments of the agricultural sector in India. The production of agricultural crops has been rising at a rate of 1.5-2 % per annum while that of eggs and broilers has been rising at a rate of 8-10 % per annum (Mehta et al 2003). Huge losses in poultry have been linked to disease causing agents such as viruses, bacteria and parasites. Parasite infections in poultry are common in deep-litter systems and in flocks with access to outdoor areas. A growing consumer demand for eggs from alternative production systems has in recent years been a contributing factor to increasing problems with parasite infections in layers. The infections may cause pathological as well as welfare problems to the hens and economic losses for the farmers. *Ascaridiagalli* has been incriminated as the most common, important and prevalent parasite of poultry (Pam et al 2006; Luka and Ndams 2007). *Ascaridiagalli* infection continue to be the most debilitating factor impeding poultry productivity resulting in retarded growth, weight loss, diarrhoea, poor absorption of nutrients, death and even the spread of fatal bacterial infections, consequently responsible for economic losses to the poultry industry (Gauyl et al 2007).

## **Etiology and transmission**

*Ascaridia galli* are nematode worm parasites. These are large, stout worms, male- 30-80mm and female 60-120mm long and are seen worldwide. The prevalence of this parasite, as revealed by several studies, ranges from 22-84% of total parasite load (Martin-Pacho et al 2005; Sherwin et al 2014). The parasite species vary: *A. galli* in fowl; *A. dissimilis* in turkeys; and *A. columbae* in pigeons. *Ascaridia galli* has a direct life cycle and

thus the infection can spread among free ranging laying hens as they are constantly in close contact with excreta and soil (Wongrak et al 2014) when they ingest the infective embryonated eggs from contaminated water or feed.

Eggs laid by the female worms pass in faeces, develop in environment and become infective in 10 days. The larvae develop inside the egg until they reach their infective stage (L2) within 10-20 days or more, depending on environmental temperature and humidity. (Tarbiet et al 2015). Eggs are very resistant and remain infective in shaded place for one to three months. The embryonated egg can survive a winter and remain infective in deep litter systems for years depending on the temperature, humidity, pH and ammonium concentration (Permin and Hansen 1998). Occasionally, earthworms can ingest *A. galli* eggs and are transmitted when the chicken ingests the earthworm (Soulsby 1982).

The route of infection is oral usually by direct ingestion of the embryonated egg and there is a 5-10-week prepatent period, shorter in young birds. Infective eggs hatch in either the proventriculus or the duodenum of the susceptible host. For the first 8 days larvae live in lumen of intestine. Thereafter, they enter the intestine mucosa (8-17 days); subsequently they reenter the lumen and reach maturity in 6-8 weeks. The young larvae, after hatching, live free in the lumen of the posterior portion of the duodenum for the first 9 days. They then penetrate the mucosa and cause haemorrhages. The young worms enter the lumen of the duodenum by 17 or 18 days and remain there until maturity, at approximately 28-30 days after ingestion of embryonated eggs (Soulsby 1982). The prepatent period varies from 5 to 8 weeks.

Adult *A. galli* worms may migrate through the lumen of the large intestine and cloaca and end up in the oviduct, where they can be incorporated into the hen's egg.

### **Pathogenesis**

The age of the host and severity of exposure play a role in *Ascaridiagalli* infections. Chickens 3-months or older manifest considerable resistance to infection with *A.galli*.

This parasitic nematode worm exists in the lumen of the intestine, occasionally in the oesophagus, crop, gizzard, oviduct and body cavity. The released larvae can cause extensive destruction and erosion of the intestinal mucosa as well as proliferation of mucus secreting cells (Sharma et al 2017). *Ascaridiagalli* infections are often associated with reduced body condition, increased feed conversion ratio, and overall reduced health conditions (Chadfield et al 2001). The infection may also act to suppress the immune system of the host thereby increasing the severity of concurrent diseases (Dahl et al 2002; Permin et al 2006). Adult birds can tolerate burdens asymptotically. Adult worms can also cause damage to the epithelia as a result of pressure atrophy of the villi, causing occasional necrosis of the mucosal layer. In chronic infections the intestinal wall can become distended as muscle tone is lost (Permin and Hansen 1998). *Ascaridiagalli* eggs ingested by earthworms hatch and are infective to chickens, although no development of the larvae occurs. Young birds are more susceptible than adult exposed birds. Dietary deficiency of Vitamin A, B, B<sub>12</sub>, many minerals, protein predispose to concurrent infections. Chicken over three months more resistant due to increase goblet cells in mucosa. Most serious infection is found in chicken of 1-3 months of age. Developing larval stages penetrate the duodenal mucosa causing haemorrhages and enteritis. At this stage birds become anaemic. Birds become weak, emaciated, egg production decreases. They may also cause intestinal obstruction (Soulsby 1982).

Chickens infected with a large number of ascarides suffer from loss of blood, reduced blood sugar content, increased urates, shrunken thymus glands, retarded growth and greatly increased mortality (Permin et al 1997). *Ascaridiagalli* can also have detrimental effects through interaction (synergism) with other disease conditions such as coccidiosis and infectious bronchitis. *Ascaridiagalli* has also been shown to contain and transmit avian reoviruses (Soulsby 1982).

### **Clinical signs**

*Ascaridiagalli* infection causes weight depression in the host, which correlates with increasing worm burden. In severe infections, intestinal blockage can occur. The clinical signs include loss of condition, poor growth, listlessness, diarrhoea and wasting, mainly in young birds. One of the most striking effects of infection, at least from an aesthetic standpoint, is the occasional finding of this parasite in commercial eggs. Presumably the worms migrate up the oviduct via the cloaca, with subsequent inclusion in the egg. Infected eggs can be detected by candling, thus eliminating a potential consumer complaint.

### **Diagnosis**

Diagnosis can be made by observing above clinical symptoms, by finding eggs in the faeces or during post mortem examination (PM). *Ascarideggs* are elliptical, thick-shelled and not embryonated at time of deposition. Evidence of haemorrhagic enteritis can be seen on PM; as large numbers of larvae in the histotropic phase can cause extensive damage to the glandular epithelium. Adhesion of the mucosal villi can also be noted as a result of the proliferation of mucous-secretory cells.

### **Treatment and control:**

Piperazine compounds in feed or water have been widely adopted as a method of treatment for ascarids, since they are practically non-toxic. Piperazine may be administered to chickens in the feed (0.2-0.4%) or water (0.1-0.2%), or as a single treatment (50-100 mg/bird). Piperazine in drinking

water is the most practical method of application for commercial flocks. Since piperazines are available as a wide variety of salts, the level should be calculated on the basis of milligrams of active piperazine. Currently used in chickens are Hygromycin B (at a level of 0.00088-0.00132%) or coumaphos in feed for replacements (0.004%) or layers (0.003%). Mebendazole @ 2g/28 kg of feed. Tetramizole @ 10% solution in drinking water is also found to be effective.

### Control and prevention.

The following control and prevention measures can be employed for the management of ascarid infection in chicken:

- Regular screening of the flock for the presence of infection and treatment of the infected birds.
- In free range systems, young birds can be isolated and put onto ground previously unused by poultry.
- The different species or different ages of birds should not be raised together or in close proximity.
- Young birds should be kept separate.
- Poultry houses should be well drained.
- Deep litter (moist one) around feeding and water pans should be changed with dry one.
- Rotation of poultry runs should be practiced.
- Raised feeding and watering stations can reduce the transmission via the faecal oral route.
- Treatment of the soil or litter to kill paratenic hosts as earthworms may be beneficial.
- Confinement-rearing of broilers and caging of laying hens significantly influences the quantity and variety of nematode infections in poultry. Confinement-rearing on litter largely prevents infections with nematodes using outdoor intermediate hosts such as earthworms or grasshoppers.
- For most nematodes, control measures consist of sanitation and breaking the life cycle rather than chemotherapy.

- Changing litter can reduce infections.

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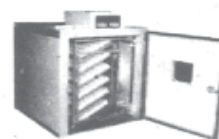
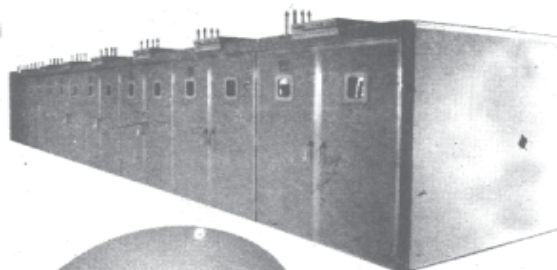
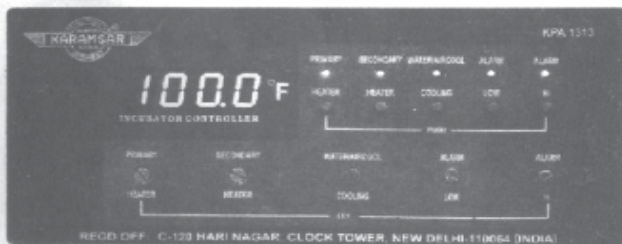
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# Safest methods of Poultry Carcass Disposal with concern about Environmental Health

K.P. Prabhakaran\* and J.Keerthana

Cattle Breeding and Fodder Development, Tamil Nadu Animal Husbandry Department,  
Thanjavur - 613 403, Tamil Nadu. \*Email: dr.prabhakaran2010@gmail.com

## Introduction

Carcass disposal possess a major problems faced by poultry egg and meat producers. It should be disposed off carefully taking care of public health, animal health and environmental protection. Proper management of dead birds is vital from the standing point of avoiding nuisance complaints. Dead birds from poultry farms should be removed twice a day. It should be recorded accurately in poultry farm records. Typical method of carcass disposal includes burial, incineration, rendering and composting. Composting, incineration and rendering are currently following disposal methods of poultry carcass.

## Composting

Composting is economically and biologically safe means of disposing the carcass. It is a controlled, natural process in which beneficial microorganisms will reduce and transform organic wastes into a useful end product called compost. It requires the use of primary and secondary compost bin with the help of composting materials like hay, litter and water. Composted carcass should be disposed off with adequate care to avoid the spread to botulism and other infectious diseases.

### Composting should includes

- Construction of proper facilities
- Availability of cost-share funds
- Heavy-equipment needs including use of a front-end loader
- Daily management, monitoring and turning requirements of compost
- Ensuring no contact with livestock if compost is applied to land

- Availability of necessary inputs of litter, straw and water

## Incineration

It is biologically safest method of carcass disposal which eliminates the risk of disease spread. But expensive smokeless incinerators are required. They must be properly operated, maintained and replaced as needed. Poor maintenance and improper operation of incinerators may leads to smoke and odour nuisance complaints.

### Considerations should includes

- Equipment emissions that meet air quality standards
- Availability of cost-share funds
- Registration of incinerators with regulatory authorities
- Expense of fuel in relation to increased operating costs
- Maximum burn rate of 200 pounds per hour. It is advisable and less expensive to limit the burn rate to 100 pounds per hour

## Rendering

The best method of disposing the poultry carcass is rendering. It convert the carcass into a protein by-product meal is environmentally acceptable. It includes size reduction followed by cooking and separation of fat, water and protein materials through mechanical or thermal or chemical process. Carcass can be converted into products such as hydrolysed whole poultry meal, fat and water. The resultant meal and fat obtained can be used as animal feed ingredients as per FDA 2006. Cooking process in rendering will destroy the

bacteria but not the endotoxin which may induce disease. The disadvantage of rendering is high cost spend on investment.

### **Burying**

This is a suitable method of disposal of birds for small farms that may not be able to afford to construct an incinerator. The best and easiest way is to dig a deep narrow trench in which buried carcass cannot be taken out. It also prevents worms from carrying infections from the carcass to the surface of ground. The dead birds should be covered with plastic bags before burying which will further reduce the chances of infection spreading.

### **Strategies for the disposal of dead birds following catastrophic poultry losses**

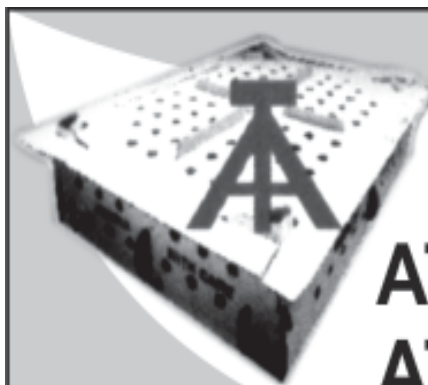
Catastrophic loss is defined as any mortality that exceeds normal mortality capacity of a poultry farm to accommodate losses within 24 hours. It may be caused by natural disaster or infectious disease outbreak or major management anomalies which may mandate depopulation or increased mortality. The loss may range from few thousand birds in a single farm to millions of birds within the specified area. Catastrophic losses can be overcome by better operational plans which should be economical, biosecure, environmentally and socially acceptable.

### **Choosing a carcass disposal methods**

Disposal methods should be selected based on the immediate farm needs. In case of catastrophic losses, the plan of disposal should be developed quickly otherwise it will add burden both on bird and environmental health. Always government approved methods should be followed for carcass disposal. The most important tools for emergency response are early detection, warning system, contingency plan and plan of action. Disposal should be done in such a way it should avoid the disease spread to human and livestock.

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# Tips to Improve Broiler Feed Efficiency

Dr Kiran Kumar, Korla, Regional sales manager, Vetphage Pharmaceuticals Pvt Ltd

Improved broiler feed efficiency is linked to improved profitability. The way to improve the productivity index is by balancing the ratio between energy needed and amino acids, and by improving the feed digestibility by different means. However, there are ways to improve the efficiency even after it is delivered to the farm. Let us take a look at some ways in which you can make the most out of your broiler feed:

**Avoid silo hot spots** – Mold consume valuable nutrients and also produce mycotoxins. If the broiler feed is moldy, it is unpalatable at best and toxic at worst. In a lot of cases, feed is dumped into dirty silos. In warm and humid climates, mold grows easily, and it is not uncommon to find patches of moldy feed stuck to the silo surface. Adding a mold inhibitor and mycotoxin binder to the feed is not enough. You must inspect and clean the silos periodically. The dosage rates that are usually recommended for mycotoxins do not take this into account, and it is an issue that can be quite serious if left unchecked.

**Use feeders properly**—Feeder management is essential to minimizing feed wastage. In the case of both straight and round feeders, feed wastage can be prevented by using the feeder with a lip and ensuring that the feeder is not more than half filled. Make sure you hang the feeder at the level of the birds' backs, and it is at least 7 cms deep. Clean them regularly and make sure that the bird capacity is just right. This will ensure that feed consumption is neither a fight to eat nor a chance to beat boredom. One way to maximize feed efficiency is to make sure that the drinkers are placed close to the feeders so that there is no spoilage.

**Use the right lighting** – Keeping the lights on is not good for feed digestibility. If the lighting is constant, the birds overconsume feed, which in turn increases the feed passage rate. Since birds are usually fed at their maximum genetic potential, the extra feed they end up consuming does not interact with the digestive enzymes and this reduces the feed digestibility. In contrast, an alternate lighting system, where the birds are exposed to one hour of light followed by three hours of darkness gave them a chance to digest the feed during the resting period, also improving the feed efficiency by curtailing their

movement. The only catch in this system is you need enough feeding spaces for all the birds to eat at the same time, which requires careful pre-placement of feeders.

**Make sure the body weight is market friendly** – If you want your birds to attain a certain market weight or market age, you should follow your contracting partners' guidelines. If you are going to sell your birds on the open market, then you need to keep in mind that the efficiency of the feed gets worse as they age. This is on account of the fact that they have to maintain a greater body mass every day, and this requires both amino acids and energy. So finding the minimum acceptable weight will also minimize the feed efficiency. Although the market rates keep fluctuating, it falls anywhere between 1100 and 1200 grams. It goes without saying that this does not ensure maximum profitability and other parameters, such as cost per kg of weight gained, and weight gain per floor surface, should also be consulted.

**Keep your birds healthy** – Although this is also obvious, it is worth mentioning. Sick birds are usually kept in isolation, but what most poultry farmers forget to pay attention to is cases of subclinical diseases. They usually go unnoticed and steal the performance by causing malabsorption and diverting energy to the immune response instead of growth. On top of that, they might even break down the muscle proteins, which reduces the body weight and brings down the feed efficiency. Subclinical coccidiosis is one of the most common causes of performance loss in broilers. Poultry producers must monitor the coccidiosis status of their flocks throughout the growth cycle and collect sequential fecal samples, which should be tested for oocyst counts per gram of faeces. Successful programmes to maximize broiler productivity must include a coccidiosis control strategy that should be formulated after discussion with a poultry veterinarian.

Not all of the aforementioned pointers are applicable to every poultry farm, but by taking at least one into consideration, breeders can improve their feed efficiency and this translates to increased profitability, which is something breeders across the country need to recover from the sales loss due to the pandemic.

## BROILER LIFTING RATES FOR THE MONTH OF JUNE 2020

Place	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Hyderabad	135	137	140	-	-	-	-	131	-	133	-	124	115	-	100	-	90	92	-	90	-	80	-	85	90	-	-	-	-	-
Karimnagar	135	137	140	-	-	-	-	131	-	133	-	124	115	-	100	-	90	92	-	90	-	80	-	85	90	-	-	-	-	-
Warangal	135	137	140	-	-	-	-	131	-	133	-	124	115	-	100	-	90	92	-	90	-	80	-	85	90	-	-	-	-	-
Mahaboobnagar	135	137	140	-	-	-	-	131	-	133	-	124	115	-	100	-	90	92	-	90	-	80	-	85	90	-	-	-	-	-
Nizamabad	135	137	140	-	-	-	-	131	-	133	-	124	115	-	100	-	90	92	-	90	-	80	-	85	90	-	-	-	-	-
Kurnool	135	137	140	-	-	-	-	131	-	133	-	124	115	-	100	-	90	92	-	90	-	80	-	85	90	-	-	-	-	-
Vizag	130	132	130	-	-	-	-	131	-	133	-	124	115	-	100	-	105	105	-	105	-	100	-	100	100	100	-	-	-	-
Khammam	130	132	137	-	-	-	-	131	-	133	-	124	115	-	100	-	95	95	-	90	-	85	-	87	92	-	-	-	-	-
Godavari	130	132	137	-	-	-	-	131	-	133	-	124	115	-	100	-	95	95	-	90	-	85	-	87	92	-	-	-	-	-
Vijayawada	122	126	137	-	-	-	-	130	124	126	-	120	110	-	100	-	95	90	-	85	-	87	87	87	92	-	-	-	-	-
Guntur	124	126	130	-	-	-	-	130	126	128	-	120	110	-	100	-	97	89	-	84	-	86	86	87	91	-	-	-	-	-
Ongole	125	126	130	-	-	-	-	130	128	130	-	120	110	-	100	-	95	88	-	83	-	85	85	87	90	-	-	-	-	-
Chittur	143	143	143	-	-	-	-	143	-	137	-	120	120	-	120	102	102	85	83	75	78	88	88	90	90	-	-	-	-	-
Nellore	143	143	143	-	-	-	-	143	-	137	-	120	120	-	120	102	102	85	83	75	78	88	88	90	90	-	-	-	-	-
Ananthapur	139	142	144	-	146	-	-	140	-	140	-	118	118	-	98	101	101	88	78	70	73	83	83	86	88	-	-	-	-	-
Kadapa	143	143	143	-	-	-	-	143	-	137	-	118	118	-	118	102	102	85	82	74	77	88	88	90	90	-	-	-	-	-
Namakkal	132	133	133	133	133	133	133	133	133	128	123	118	108	108	108	90	85	80	68	68	68	73	83	86	86	77	68	68	71	73

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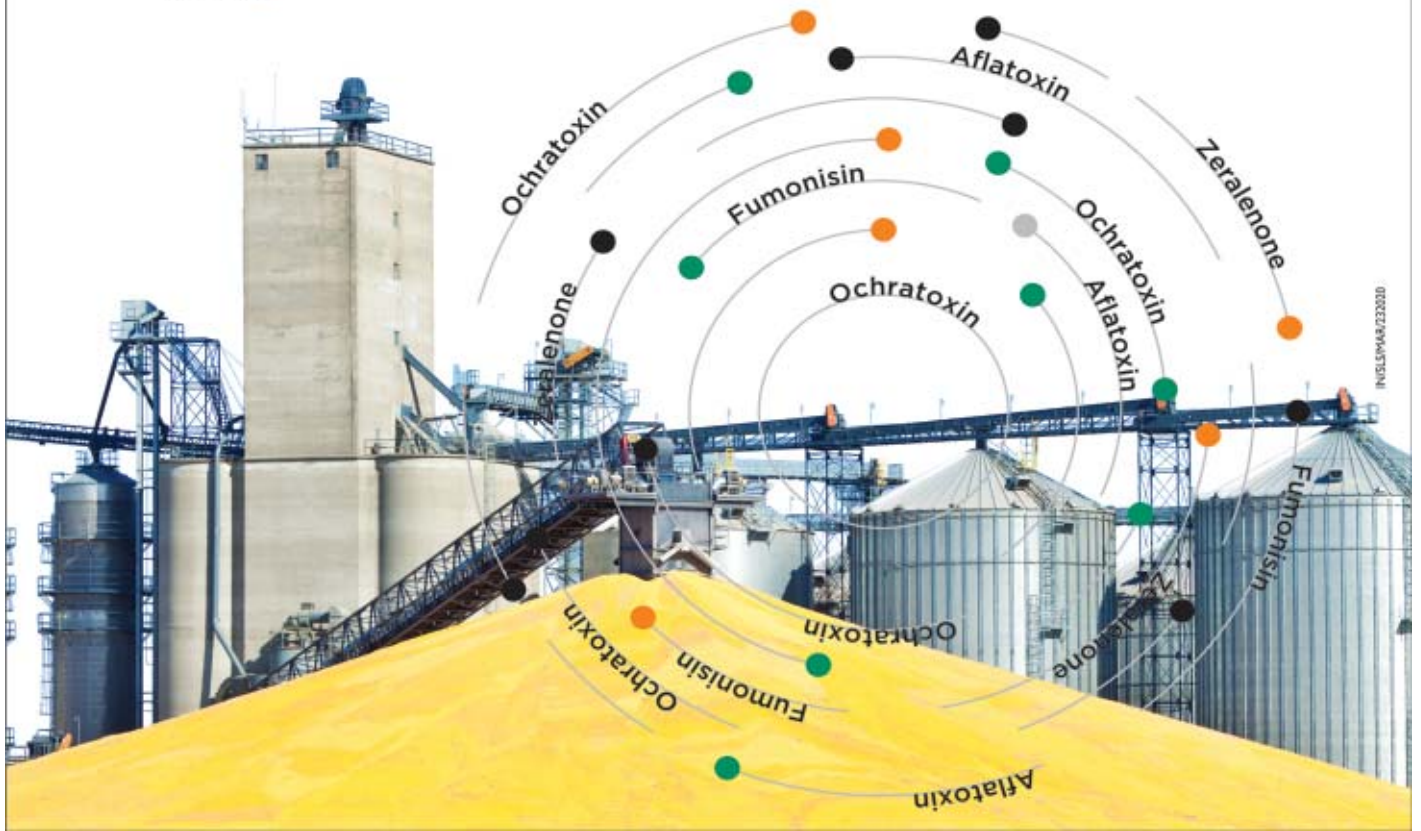
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- Improves pigmentation
- Has hepatoprotective action
- Enhances immune-stimulation effect
- Any many more...

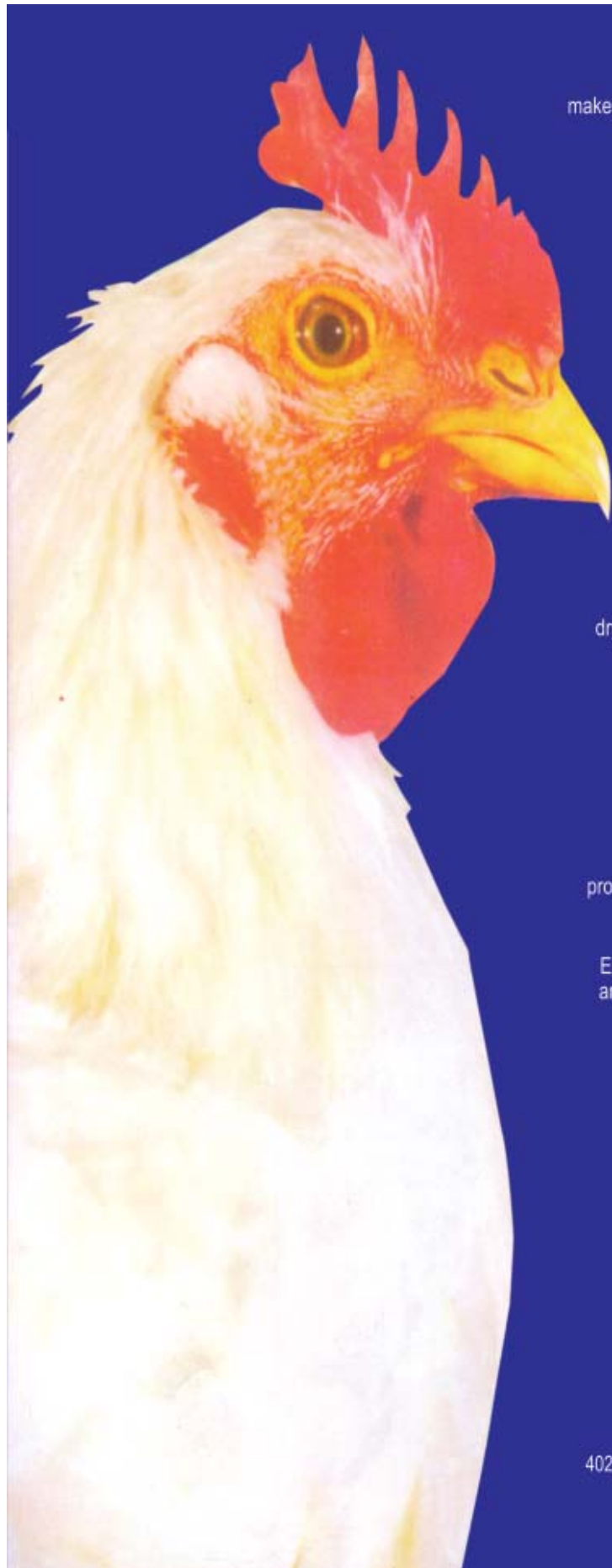
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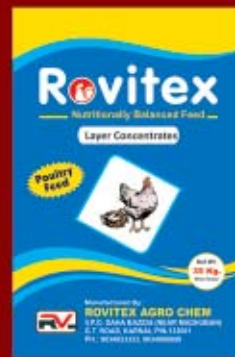
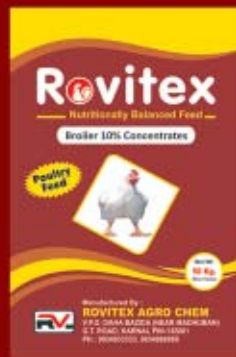
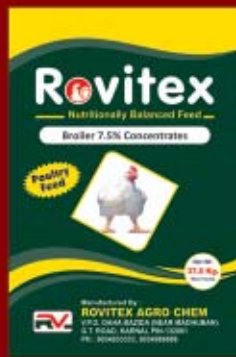
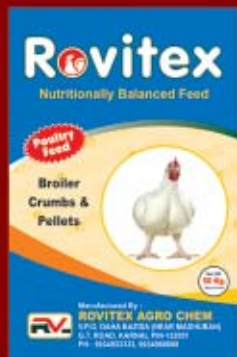
- ❖ Broiler 10% Concentrates
- ❖ Broiler 7.5% Concentrates
- ❖ Broiler 5.5% Concentrates
- ❖ Broiler 3.5% Concentrates
- ❖ Broiler 2.5% Concentrates
- ❖ Broiler 1.5% Concentrates

### Layer Concentrates:

- ❖ Layer 5% Concentrates
- ❖ Layer 10% Concentrates
- ❖ Layer 25% Concentrates
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## How Phytochemicals Add Value for Feed Producers and Integrations

Authored by Antonia Tacconi



Phytochemical feed additives have a range of properties that support livestock production, including antioxidant, anti-inflammatory, anti-microbial and nutrient absorption-enhancing effects, and can help prevent problems such as scours in pigs. But understanding how to combine phytochemicals - and what to provide to animals in each stage of production - is key to maximizing their benefits.

Phytochemical feed additives are mixtures of plant-derived material containing active ingredients that can be considered as part of secondary plant metabolites. These secondary metabolites are generally produced by plants for three reasons:

1. They play an important role in protecting the plant from both abiotic and biotic stress.
2. They are needed by the plant to attract different pollinators.
3. They play an important role for the defense of the plant itself.

In fact, some of these metabolites can help against herbivores (for example, repellants or because they are toxic to the organisms), but also against different microbes (by inhibiting the growth of the microbes or reducing their virulence). They are also important in helping the plant compete against other plants, such as when they inhibit germination of an adjacent plant or inhibit the growth of seedlings.

### The role of phytochemicals in animal nutrition

Phytochemicals are known to have a range of biologically active properties that are beneficial in modern livestock production, including antioxidative, anti-inflammatory, anti-microbial and nutrient absorption-enhancing effects. According to results of the BIOMIN Phytochemical Feed Additives Survey, we have a clear picture of the reasons that nutritionists, growers, business owners, veterinarians and consultants use or recommend the application of phytochemical feed additives in animal diets

### Top reasons for applying phytochemical feed additives:

- Digestibility enhancement
- Antimicrobial effects
- AGP replacement strategy
- Growth promotion
- Anti-inflammatory effects
- Good past experience
- Better feed conversion ratio
- Higher feed intake

**Source:** *BIOMIN Phytochemical Feed Additives Survey*

### Commodity vs. innovative value proposition

These secondary metabolites can be very versatile in their modes of action, and their characteristics can help improve and support animal production. The raw materials used for phytochemical feed additives can be bought as commodities. However, the level of active substances in these commodities naturally varies, so it's important to have strict purchasing and quality control guidelines in place to ensure that the supplement delivers the expected results.

Simplicity comes at a cost to feed producers. Although individual phytochemical feed additives can be useful, research has documented additional benefits of specific combinations of active plant-based substances. Scientifically formulated, more complex products typically outperform single ingredients when it comes to

encouraging feed intake, supporting gut performance and delivering a return on investment. At BIOMIN, the fundamental concept when formulating phytogenics feed additives is to consider the interaction between various active compounds and identifying the correct combination to best support feed and animal producers at the specific production phase for each species.

This requires an important investment in terms of time, money and other resources into research and development. Only this ensures a better understanding of these dynamics and allows producers of phytogenic feed additives to offer the best and most cost-effective solutions for the market.

**Unique formulation:** Recently our cutting-edge **Digestarom® DC** technology received approval as a zootechnical feed additive from the European Commission. This is a major achievement for the company as the results that can be achieved with the product were validated by external bodies and they agreed that the product works and consistently delivers the expected results. The process to get such a registration is quite laborious and long and there are still just a few companies who have been successful with the process. BIOMIN is the only feed additive producer offering EU authorized solutions for both mycotoxin risk management and phytogenics.

#### **Withstanding feed processing**

The Duplex Capsule (DC) technology is extremely important when it comes to the application of some of the most used phytogenic compounds used in the animal industry e.g. oregano oil and its derivative compounds. In fact, one of the characteristics of essential oils is that they are the volatile and degrade when exposed to high temperatures. The unique DC encapsulation technology ensures that these volatile compounds are protected during pelletization, extrusion or expansion.

#### **BIOMIN has a long track record in the market**

At BIOMIN we have a long history with phytogenic feed additives. Our experience dates back more than 30 years and we have been serving the markets with the best available products. Our products are sold all over the world with great



success. We have loyal customers and we constantly strive to understand their challenges in animal production to improve and further develop our product concepts.

#### **Understanding production challenges is key**

Understanding best practices in animal production and the challenges related to operations all over the world are key to develop the right products. Our experience shows that although it would be ideal to have one solution for all species and all phases, it is almost impossible to find a product that can do it all, especially if one wants to be cost-effective. The reason for this is related to the different challenges that an animal undergoes in the different phases of production.

Consider as an example swine production, where the challenges facing a newborn piglet differ considerably to the challenges faced by a finisher pig or a sow. For this reason, our priority has always been understanding the dynamics of animal production. For a newborn piglet many problems could occur: chilling, failure of colostrum intake, diarrhea, birth defects and crushing

Clearly some of these problems cannot be solved by a phytogenic feed additive or any other nutritional strategy - these require management solutions. However, certain issues can be addressed by using the correct feed additive at the right time with the right dosage

**Conclusion:** These are just a few examples of how BIOMIN approaches the development of phytogenic feed additives. It is important to make sure that the market is understood and that there is a clear exchange of information between customers and producers. Only this can guarantee that products available address market needs and satisfy customers' expectations.

# All Clays are not created equal

Douglas Zaviezo, Ph. D.

Special Nutrients

MYCOTOXINS 2011 - Thailand March 2011



**INTRODUCTION:** Practical methods to detoxify mycotoxins contaminated grain or feed on a large scale and in a cost-effective manner are not currently available. At present, one of the most practical approaches consists of using adsorbent materials in animal diets to reduce the absorption of mycotoxins from the gastrointestinal tract. Clays are an important group of products that have been used successfully worldwide to reduce mycotoxicosis; and all commercial anti-mycotoxin additives or mycotoxin inactivators available in the market are clay based products.

## CLAYS

Clays are complex and widely diverse aluminosilicates with a variety of functional properties, but they are often grouped into a single category. This is very misleading since there are many types of clays, which are completely different from one another.

Many types of clays do not capture mycotoxins; some can absorb water, others can absorb ammonia, and only certain clays can adsorb mycotoxins. The first effective mineral adsorbent was described as hydrated sodium calcium aluminum silicate (HSCAS), and others have subsequently used this nomenclature. Because HSCAS is a generic description, it does not specifically define the material of use. The majority of mycotoxin binding products are classified as montmorillonite, belonging to the phyllosilicate group, which is composed of layers of aluminum and silicon connected in a 1:1 or 2:1 arrangement.

Not all clays that adsorb mycotoxins are equally effective in protecting animals against the toxic effects of mycotoxins. Even some montmorillonite adsorbents are not always the best binders. Furthermore, the adsorption ability of similar clays may vary from one geological deposit to another.

Besides their origin, formation and structure, clays can vary in chemical composition, surface acidity (pH), electrical charges (polarity), distribution of exchangeable cations, and porosity and expansibility characteristics. Despite all these differences, there is no significant correlation between any single physical or chemical property and the mycotoxin binding capacity of clays.

Therefore, the effectiveness of a mycotoxin adsorbent is tested by conducting evaluations *in vitro* and *in vivo* to demonstrate a statistical significant response in preventing mycotoxicosis. The dosage of the adsorbent and the level of the mycotoxin used in these tests must always be reported. Also, it is important to demonstrate the innocuity of the product when it is evaluated without the presence of mycotoxins.

## ANTI-MYCOTOXIN ADDITIVES (AMA) EVALUATION

The *in vitro* test must be conducted with high performance liquid chromatography (HPLC) using a methodology using two types of solutions: one of pH 3 and another of pH 6, mimicking the gastric and the intestinal juices. For the *in vivo* test there is a standard experimental protocol consisting of four treatments: a control without mycotoxins; a control with adsorbent; a control with mycotoxin; and one with mycotoxin plus adsorbent. Additional treatments can be added to this experimental design, such as different testing levels of the adsorbent.

The amount of an adsorbed mycotoxin is difficult to calculate; therefore in the *in vivo* trial, the efficacy of adsorption has to be determined by the animal performance (body weight gain, feed consumption and feed efficiency) and the target organ protection.

It is important to evaluate the target organ(s) since they reflect the specific damage of the mycotoxin.

It is also necessary because some adsorbents base their effectiveness on a positive effect on performance, which is a result of the presence of enzymes, beneficial bacteria, yeast and /or immuno-stimulant in the composition of those products, and not mycotoxin adsorption.

The relation between *in vitro* evaluation and *in vivo* effectiveness cannot always be confirmed. In evaluations done by Dr Mallmann and collaborators in LAMIC on 58 AMA for different toxins and species, little more than 55% of AMA approved *in vivo*, had an adsorption greater or equal to 90% at pH 3 and 6. For AMA approved *in vivo*, more than 50% had an adsorption less than 70% at pH 3 and 6 (Figure 1). There was no significant correlation between *in vitro* and *in vivo* evaluations when the data of those 58 *in vitro* and *in vivo* evaluations were submitted to a linear regression analysis. The greatest correlation found was in broiler chickens, at pH 6 with fumonisins ( $P < 0.07$  and  $R = -0.55$ ), followed

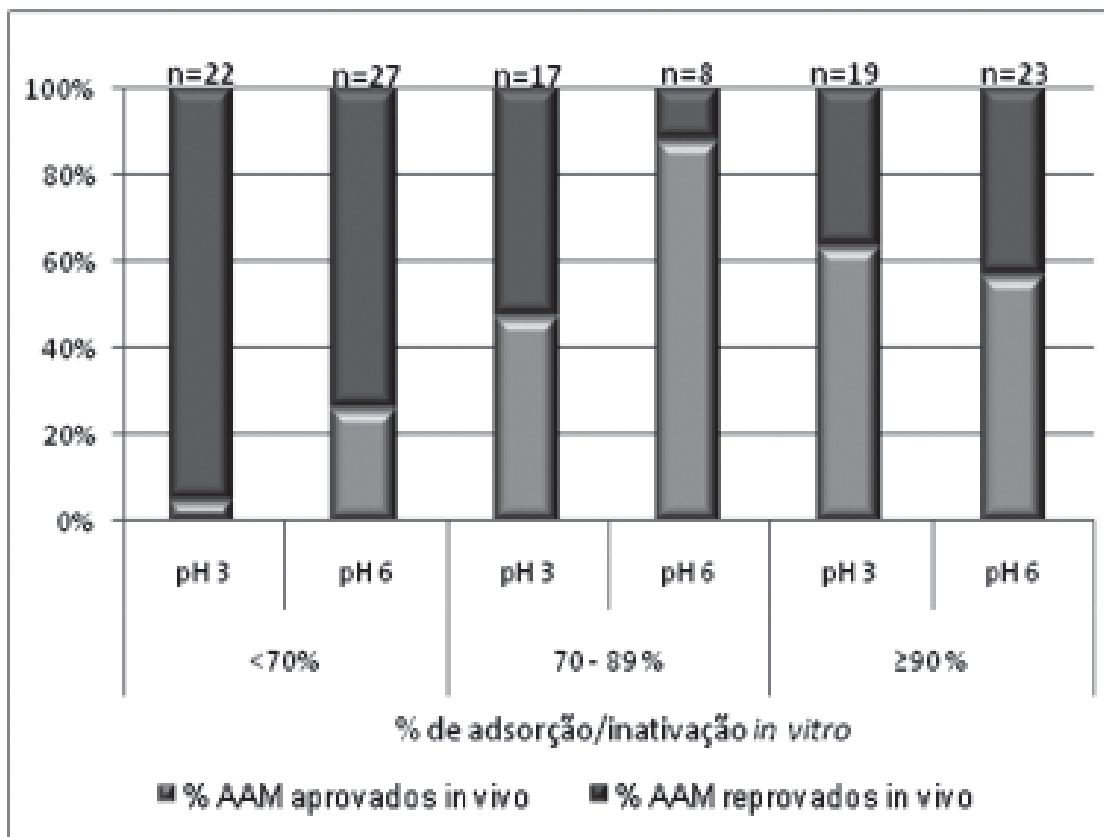
by correlation for swine at pH 6 with aflatoxins ( $P < 0.1$  and  $R = 0.55$ ). These analyses showed that some products that were not very effective in laboratory conditions can often function satisfactorily in the *in vivo* trials.

It is evident from this data that the results obtained from *in vitro* evaluations are not sufficient to prove the efficiency of an AMA. Therefore, statistical satisfactory results from the *in vivo* test are necessary to determine the efficacy of an AMA.

### CLAYS AND AFLATOXIN ADSORPTION

During the last 20 years, various scientific studies have demonstrated that some aluminosilicates are very effective in preventing aflatoxicosis. In the program for approval of anti-mycotoxin additives, conducted by LAMIC in Brazil, 16 out of 32 products evaluated were proven to be efficacious against aflatoxin in broiler chickens and only 4 out of 12 in swine. All the effective products are or contain clays.

**Figure 1 - *In vitro* adsorption of 58 approved or rejected AMA *in vivo*. (LAMIC)**



Mallmann and Dilkin (2011)

The majority of the clays that significantly ameliorate the toxic effects of aflatoxins have been reported to be effective at an inclusion rate of 5 or 10 kilos per metric ton of feed. Only a few, including Myco-Ad, significantly prevented aflatoxicosis at 2.5 kg/mt of feed. Recently, Myco-Ad has become the first and only product approved by LAMIC against aflatoxin in three different species: poultry, swine and cattle.

Very few products are effective against more than one type of mycotoxin; among these, Myco-Ad is exceptional because it has been scientifically proven that Myco-Ad ameliorates the deleterious effects of aflatoxin, in the three species mentioned above; and prevents the toxic effects of ochratoxin, T-2 toxin and fumonisin in broiler chickens.

#### PURIFIED PHYLOSILICATES

In recent years, special proprietary processes have been developed for the production of purified and activated phylosilicates with the objective of producing adsorbents capable of binding fusariotoxins such as zearalenone (ZEA), deoxynivalenol (DON), fumonisins, and T-2 toxin,

which are especially toxic for swine. After the process, these phylosilicates become very light, showing a much lower density and particle size than regular clays. Normally, these products have been effective when added to animal diets at a very low dosage (0.5 to 2.0 kg/mt).

One of the few purified phylosilicates is Myco-Ad A-Z which has been scientifically proven to be efficacious in preventing the toxic effects of T-2 toxin in broiler chickens, and fumonisin and zearalenone in pigs.

Recently, the efficacy of Myco-Ad A-Z in reducing the natural toxicity caused by ZEA + DON contaminated feed was evaluated in gilts. Results of this experiment indicated that the deleterious effects of ZEA+DON in prepubertal gilts were completely independent from each other. ZEA caused hyperestrogenism and DON resulted in poor performance with reduced liver size. The addition of 1 kg of Myco-Ad A-Z per metric ton of feed prevented both the toxic effects of DON and the estrogenic effects of ZEA in prepubertal gilts. (Table 1, Table 2, and Figure 2).

**Table 1. Effects of Myco-Ad A-Z on body weight gain, total feed intake, and feed conversion ratio of 40 day-old gilts exposed to test diets for 21 days.**

TREATMENT	BODY WEIGHT GAIN kg	ESTIMATED FEED INTAKE kg	FEED INTAKE + WASTE * kg	FEED + WASTE CONVERSION RATIO
Control	2.94 a	6.76 a	14.06 a	4.77 a
1.2 ppm ZEA + 6 ppm DON	1.04 b	2.39 b	13.33 a	12.82 b
1.2 ppm ZEA + 6 ppm DON + 1 kg/mt Myco-Ad A-Z	2.22 a	5.11 a	12.25 a	5.53 a

a, b Means within columns with no common letter differ significantly (Pd" 0.05)

\* Waste of feed was noticeable in pigs from ZEA+DON treatment. Pigs from other two treatments (Control and ZEA+DON+MYCO-AD A-Z) imitated that behavior.

**Table 2.**

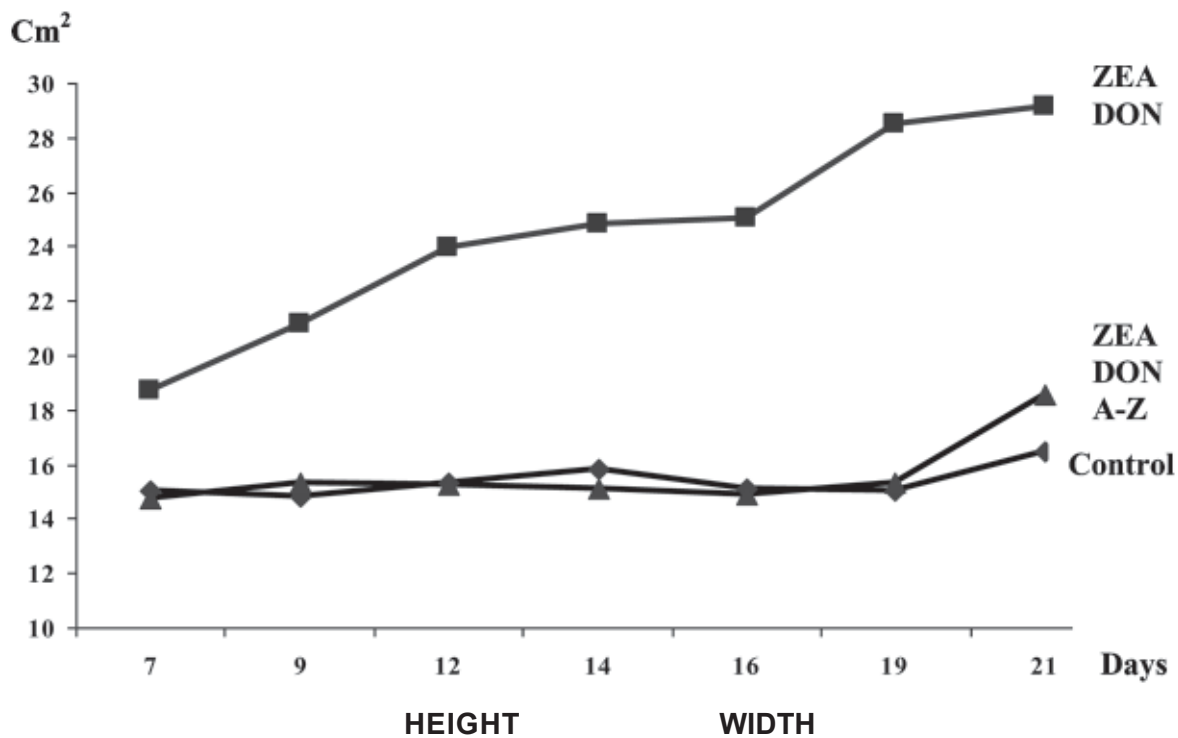
Effects of Myco-Ad A-Z on the relative liver and internal reproductive system weight of 40 day-old gilts exposed to test diets for 21 days

TREATMENT	LIVER g/100 g Body Weight	REPRODUCTIVE SYSTEM g/100 g Body Weight x 1000
Control	3.76 a	53.9 a
1.2 ppm ZEA + 6 ppm DON	2.89 b	104.5 b
1.2 ppm ZEA + 6 ppm DON + 1 kg/mt Myco-Ad A-Z	3.12 c	89.5 c

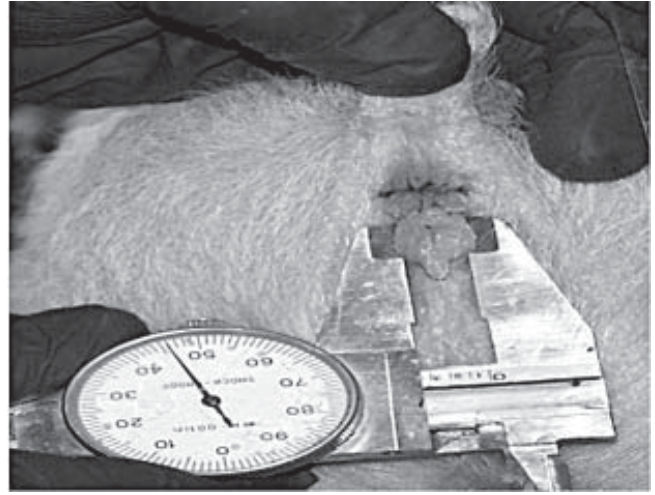
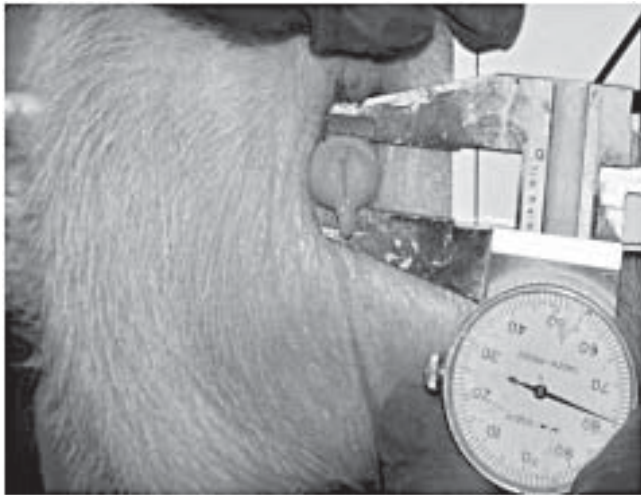
a, b, c. Means within columns with no common letter differ significantly (Pd<sup>n</sup> 0.05)

**Figure 2.**

Effects of Myco-Ad A-Z on the vulva measurements of gilts at different ages exposed to test diets for 21 days.







## CONCLUSIONS

Clays based products are the most effective mycotoxin adsorbents. However they are diverse aluminosilicates with a variety of properties. Many types of clays do not capture mycotoxins; some can absorb water, others can absorb ammonia, and only certain clays can adsorb mycotoxins.

There is no significant correlation between any single physical or chemical property and the mycotoxin binding capacity of clays. Therefore, the effectiveness of a mycotoxin adsorbent has to be evaluated by conducting *in vivo* test using a scientific experimental design which measures the beneficial effects of the product on animal performance and on the target organ(s) affected by the mycotoxin being studied.

Scientific studies have demonstrated that some aluminosilicates are very effective in preventing aflatoxicosis at an inclusion rate of 5 or 10 kilos/mt of feed; and only few, can do it at 2.5 kg/mt. Very few products are effective against more than one type of mycotoxin. Recently, special purified phyllosilicates have been developed, which are capable of binding fusariotoxins such as zearalenone, deoxynivalenol, fumonisins, and T-2 toxin at very low inclusion rate (0.5 to 2.0 kg/mt).

**For Further information Please contact :**

**Dr. Parag P Mahadik**

**09421691240**

Venkys india Ltd ., Venkateshwara House, S.No. 114/A/2, Sinhagad Road, Pune, Maharashtra 411030

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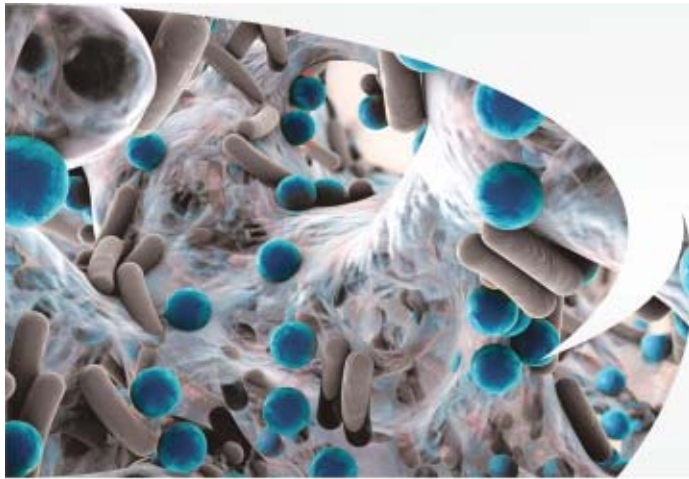
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TECHNO VIEW

### Introduction

Gut health of poultry has broad implications for the systemic health of birds, animal welfare, the production efficiency of flocks, food safety, and environmental impact.

Gut health is necessary to maintain efficient and sustainable gastrointestinal tract (GIT) physiology. The GIT has digestive, absorptive, metabolic, immunological and endocrinological functions. This means that disruptions of Gut health can affect one to several systemic functions. There is no doubt that healthy avian guts are essential to optimize digestibility, minimize nutrient excretion, and consequently mitigate the environmental impacts of ammonia, odours, and other gas emissions with health and welfare impacts inside and outside the poultry house that can impact the health and welfare of birds and human workers.

High litter moisture and ammonia production may impact the incidence and severity of footpad dermatitis, hock burns, carcass quality defects and respiratory diseases. No doubt, gut health is one of the most important factors which influence the performance of the bird. Being the largest immune organ of the body, its health impacts the overall immune status of the bird. Gut is the first line of defence and combats a number of things like that of disease-causing bacteria, mycotoxins, poor quality feed and water etc. Hence, modifying gut health in a way to strengthen its immune function and

improving nutrient absorption should be the primary goal of every producer. In this context, the structure and functionality of the gut microbiota is crucial for the health of poultry since the process of acquisition and maturation of the gut microbiota throughout the growth cycle of the birds has a strong influence on the development of the intestinal epithelium and the modulation of the physiological functions.

### Microbiota of Poultry Gut

Gut is structurally a complex system with a primary role of digestion and absorption of nutrients and water. It is the major site of development, residence and entry portal for disease-causing microorganisms. Therefore, any change in the gut morphology and physiology often leads to a disease condition and further into a decrease in performance of the bird. The morphological and physiological changes in the gut are often caused due to the effect of imbalance in the number of resident bacteria, which is called as dysbacteriosis.

Dysbacteriosis can be a serious concern during the early phase of life. In broilers, the first 15 days are crucial since the maximum organ development takes place during this phase. In breeders and layers, the first 7 weeks are crucial. These phases of life are also associated with a faster growth rate which demands optimum availability of nutrients. If the bird's gut is experiencing dysbacteriosis, this can lead to a deficiency of the crucial nutrients along with excessive expenditure of energy to tackle the sub-clinical infection. This dysbacteriosis can be tackled

by various means like that of antibiotics, prebiotic, probiotics, acidifiers, herbs, essential oils, and combination of organic acids and essential oils.

### Role of Organic Acids in Gut Health

Organic acid treatment to tackle and prevent dysbacteriosis includes mixture of various acids which have been found to have antimicrobial activities similar to that of antibiotics. The antimicrobial activity of organic acids is pH dependent. The primary action of these acids are on acid intolerant bacteria like Salmonella, Campylobacter, Clostridium and E. coli. This also helps in improvement of protein and energy digestibility by reducing microbial competition with the host for nutrient and endogenous nitrogen losses. Organic acids decrease the pH of digesta and increase pancreatic secretion and also have beneficial effect on intestinal mucosa. They reduce the colonization of microbes on intestinal walls and thus prevent damage to epithelial cells. Apart from its beneficial effects on gut health, organic acids also help in lowering down the uncontrolled variables such as buffering capacity of dietary ingredients.

### Essential oils and Gut health

In recent past, Essential Oils (EO) have gained attention from poultry industries. This is due to visible benefits of EO's after addition of it in feed. Essential oils are not simple compounds. They are mixture of various compounds which majorly comprises of terpenes and terpene derivatives. It helps improve nutrient digestibility. Decreased numbers of pathogenic bacteria in the gut may improve the ability of epithelial cells to regenerate villus and thus enhance intestinal absorptive capacity. As far as the safety is concerned, EO's are generally considered as safe and do not possess any noted side effect on birds health. Improvement of growth indices was observed along with increase in villus height in chickens significantly in Clostridium perfringens challenged birds supplemented with essential oil.

### Tributyryn in Gut health

Butyrate is an active molecule of Tributyrin, a SCFA that is produced by bacteria in the gut. Tributyrin is a valid alternative to butyrate, as one molecule of tributyrin releases three molecules of butyrate directly in the small intestine, thus butyrate is rapidly adsorbed. Aside from its primary function as an energy source for colonocytes, it is a strong mitosis promoter and a differentiation agent for intestinal epithelial cells, as it acts as a histone deacetylase (HDAC) inhibitor. Moreover, it has a strong antibacterial activity against both Gram-negative and Gram-positive pathogens and therefore proves to be a valid aid for gut health maintenance. Butyric acid exhibits bactericidal activity when the acid is undissociated. This undissociated acid is absorbed by bacterial cell led to change in the intracellular pH and results in death of bacteria. Multiple studies showed the improvement of growth performance, the repair of damaged intestinal tissues and the improvement of protein digestibility. The higher growth performance and the improvement of protein digestibility suggest that tributyrin could modulate protein and lipid metabolism. Thus, blood metabolites, insulin and leptin, which are positively correlated with body weight and with adipose and also muscle mass, could be modulated by tributyrin supplementation.





**ButyBlaster** is Gut Health Management (GHM) program by OPTIMA LIFE SCIENCES which optimizes gut health throughout the life cycle of the bird. ButyBlaster is a unique program comprising of products with proven performance and economical benefit to the poultry producer. It promotes gut health in most crucial stage of life of the bird. ButyBlaster comprises of following products with excellent health benefits to birds and poultry producers:



**ButyEster Advance** is a innovative product comprising of Tributyrin prepared by unique GEH technology. With GEH technology, Butyric acid efficiently released into hind Gut even in absence of lipase in young as well as in adult bird.

**As a AGP replacer:**

- It controls pathogens, promotes gut health and development
- Enhances intestinal barrier functions
- Enhances immune system by reduces release of pro-inflammatory cytokines
- Helps in proliferation and maturation of intestinal cells

Benefits in Broilers
Controls pathogen without antibiotic resistance
Increases cellular integrity in hind gut
Optimizes FCR
Helps in preventing coccidiosis

Benefits in Breeders
Promotes gut health
Enhances immunity
Helps optimum nutrition uptake
Helps reduce subclinical gut infections

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**Bactocid EO** is a powerful combination of organic acids and essential oil. This synergistic effect of organic acids and oregano oil various disease causing bacteria. Organic acids ensure acidic pH in gut which have bacteriostatic effect while the oregano oil decreases the crypt depth and boost villus height.

- Optimizes intestinal health
- Reduces gut pH thereby inhibiting growth of pathogenic bacteria
- Improves FCR and body weight
- Combats subclinical gut infections like that of *Salmonella* and *E.coli*.

Benefits in Broilers
Reduces buffer value of feed
Optimizes gut health
Improves FCR
Helps control <i>Clostridium</i> and <i>E.coli</i>

Benefits in Breeders
Helps maintain acidic pH in gut
Helps in optimum feed digestion
Improve immunity
Reduces subclinical infections like <i>Salmonella</i> & <i>E.coli</i>

### Suggested

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**Broilers:**

Day 1 to 15 : **ButyESTER** @ 300 gm/ton of feed  
Day 15 to 35 : **BACTOCID<sup>EO</sup>** @ 1kg/ton of feed

**Breeders:**

Week 1 to 3 : **ButyESTER** @ 300 gm/ton of feed  
**BACTOCID<sup>EO</sup>** @ 500 gm/ton of feed

Week 3 and above : **ButyESTER** @ 300 gm/ton of feed week a month program  
**BACTOCID<sup>EO</sup>** @ 1kg/ton of feed

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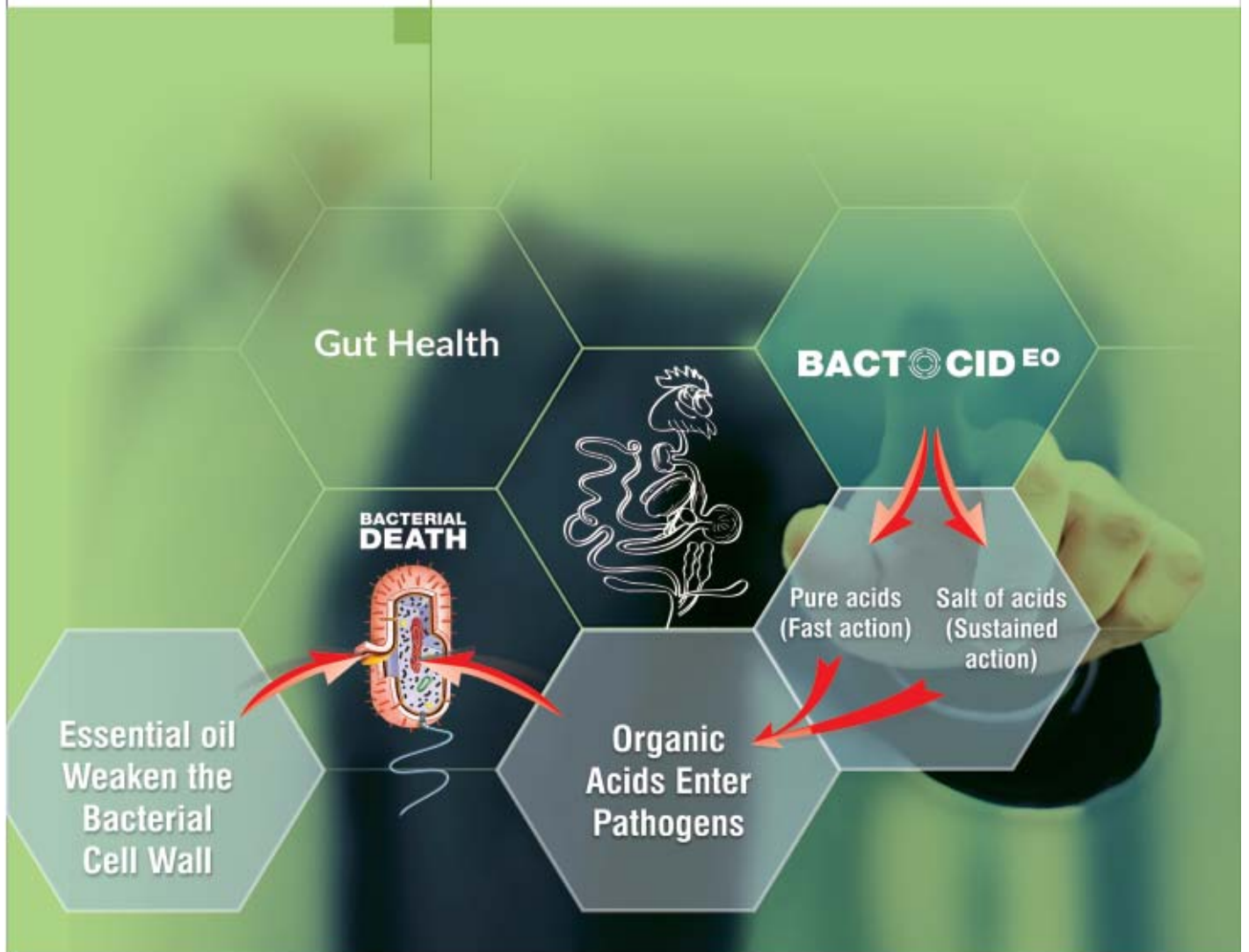
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DR.MANOJ SHUKLA, a renowned poultry Veterinarian, with 20 years of enriched field experience, now started Free Lance Poultry Consultancy. In the past 20 years have contributed to the development of the hatcheries in various capacities of leading companies across India - Maharashtra, Gujarat, Madhya Pradesh, Chhattisgarh, Orissa, Bihar, West Bengal, Jharkhand, North-East, Uttar Pradesh and neighbouring country of Nepal.



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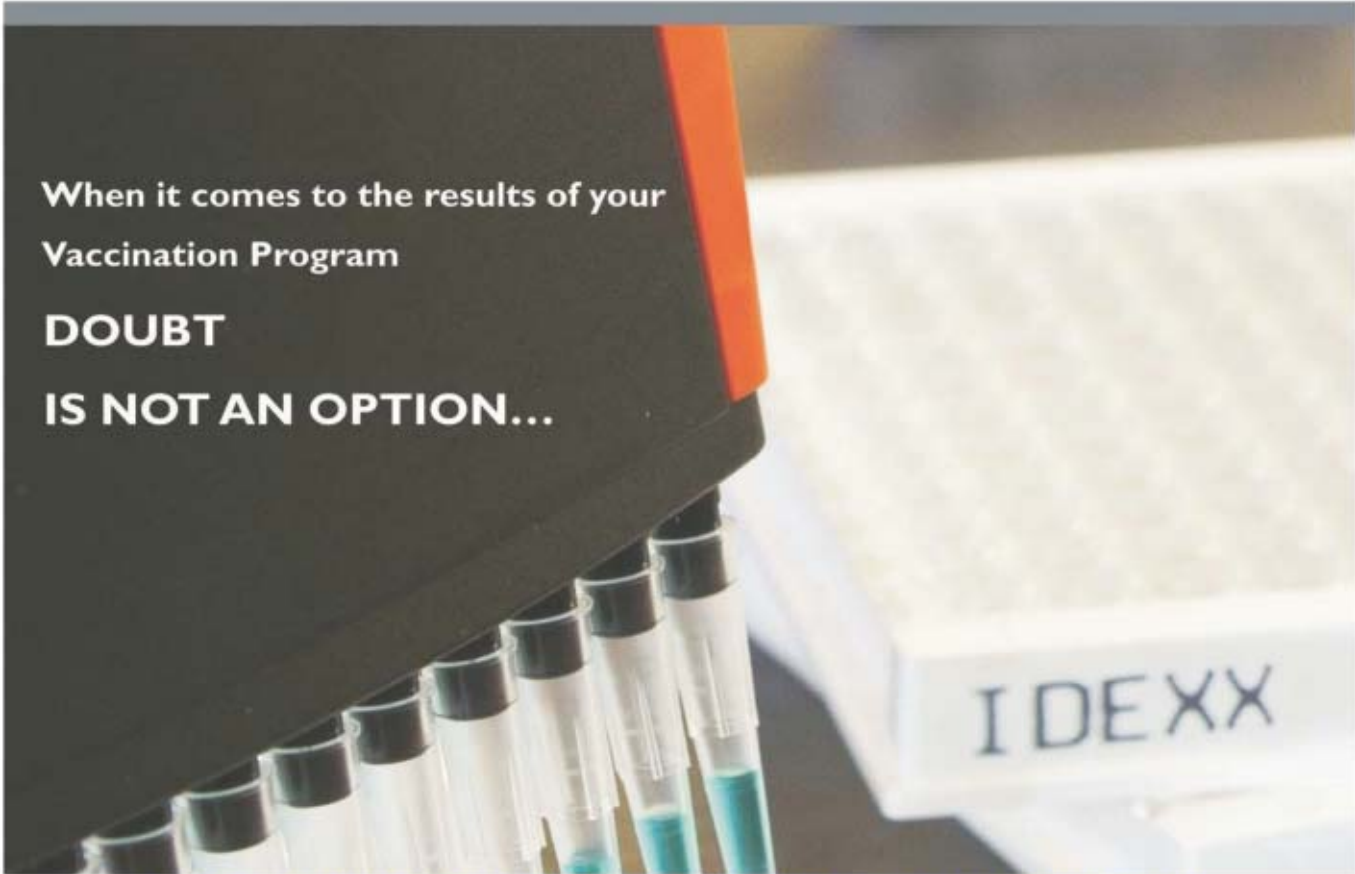
He can be Contacted at:- **Dr. Manoj Shukla**

A-1, Gaytri Nagar, Phase-II, P.O. Shankar Nagar, Raipur, Chhattisgarh-492007

Mob.No : 09644233397, 07746013700, Res. 0771-4270230

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**Dr. Koushik De**

# Role of Fibre in Layer Diet

-Dr. Koushik De, Director, Technical Services. SCA, Novus International

In the recent past Fibre was not so much important particularly in commercial layer diet, though it was a part of feed formulation depending on

the raw materials used around the world. The most common raw materials used in layer diets are corn and soya, but other grains like different brans, MDOC, SFDOC etc are also being used in different countries depending on availability. In recent times new scientific work shows that fibre and structured materials have a lot of benefits in layers' diets and should be used as a tool to improve nutrition of layer breeds under varying circumstances and under probably varying raw material availability.

Digestible Fibre (DF) is generally defined as the non-digestible fraction of plant cell walls in food and feed ingredients and typically includes oligosaccharides, pectin polysaccharides, hemicellulose, cellulose, lignin, gums, and some minor associated plant cell wall substances.

Vegetable roots and fruits like apple, beetroot, oranges provide mainly soluble fibre which is pectin whereas all kinds of cereal brans like rice bran, rice polish, wheat bran etc provide higher amount of insoluble fibre which is cellulose. In order to more accurately predict the nutritive effect of fiber from raw materials, a better characterization of fiber fractions, their degradation in the chicken, and their physiological effects are required. Traditional analytical methods to analyze fiber, as crude fiber (CF) and neutral detergent fiber (NDF), recover only a variable part of the fiber fraction and are hence unfit to evaluate fiber fractions in raw materials and poultry diets. In the chicken, solubilization is a prerequisite for fermentation, but even if solubilized during the digestive processes, a substantial part of non-starch polysaccharides (NSP) may remain undegraded.

There is some evidence that insoluble fibres have a positive effect on selected parameters in poultry production. Thus, digestibility of starch is higher and digesta passage rate faster when a moderate level

<b>Soluble fibre:</b>	<b>Insoluble fibre:</b>
<ul style="list-style-type: none"> <li>- Dissolve or swell (gel formation) in water</li> <li>- Pectins, gums, soluble NSPs</li> <li>- Decrease Intestinal Passage rate</li> <li>- Energy source for monogastrics</li> <li>- Bind bile acids, enhance viscosity</li> <li>- Fermented in small intestine (pathogen multiply)</li> </ul>	<ul style="list-style-type: none"> <li>- Not soluble in water</li> <li>- Mainly lignin, cellulose &amp; hemicellulose</li> <li>- Faster Intestinal passage rate,</li> <li>- No energy source for young monogastrics.</li> <li>- Prevents cannibalism.</li> <li>- Stimulation of intestinal villi, poorly fermentable or inert.</li> </ul>
↓	↓
<b>Fermentable Fibre</b>	<b>Non Fermentable Fibre</b>
<ul style="list-style-type: none"> <li>-Resistant to digestion &amp; absorption in small intestine.</li> <li>-broken down by bacteria in the large intestine.</li> <li>-act as a prebiotic</li> </ul>	<ul style="list-style-type: none"> <li>-improves starch digestibility</li> <li>- not broken down by bacteria in the large intestine.</li> <li>-support peristalsis, increases faecal bulk.</li> </ul>

of insoluble fibre is present in the diet. Due to the faster passage rate there is less accumulation of toxic substances in the intestinal tract. The effect of insoluble fibre on gut function stems from its ability to accumulate in the gizzard, which seems to regulate digesta passage rate and nutrient digestion in the intestine.

#### **Fibre in layer diet:**

Now a days many breeding companies are emphasizing in their feeding guidelines importance of fibre in layer diets. Insoluble NSP used in the later part of the rearing period can positively influence the development of the digestive tract, the crop size and the appetite of the pullets. This is the reason why breeding companies implements a minimum recommendation of crude fibre (5-6%) in the developer feed. During the second half of the rearing period it is highly recommended to increase crude fibre in the developer feed with the aim to create a good and sufficient feed intake capacity for a pullet which is able to start with sufficient daily feed intake and high performance after transfer to the layer house and to show up the real genetic potential. Although high density diets can be used to improve body weight gain, the sustained feeding of diets with higher than recommended energy contents or with a low fibre content can result in inadequate development of the birds' capacity for feed consumption leading to low feed intake and low egg production during early lay. According to Lohmann Tierzucht, cereals and their byproducts (bran) or oil seed byproducts (meal of sunflowers) can be used as a source of crude fibre. They point out that the recommended crude fibre content is difficult to achieve with a classical corn-soya formulation. In such cases crude fibre products based on lignocellulose are an option, as they are high in fibre (50- 65%), free of mycotoxins and do not consume too much space.

#### **Cannibalism and Fibre in Layer diet:**

Mortality caused by cannibalism continues to be a major problem in the layer industry. Up to 20% mortality from cannibalism has been noted in some

strains, depending on the production system and management strategies. Beside the management, the genetics and the lighting program, dietary factors like low protein diets, low sodium intake as well as a lack of some essential amino acids are seen as the causes of cannibalism. More and more trials also show the importance of an adequate level of insoluble fibre in the formulations to prevent cannibalism. Insoluble fibre has a positive impact on performances in terms of laying percentage as well as on animal welfare. Soluble fibre on the other hand depresses the digestibility of protein, starch and fat due to their negative impact on digesta viscosity. Layer farmers all around the world know the problem that sometimes layer flocks in non-cage housing systems tend to eat litter and feathers. With regard to the new knowledge and experience in terms of crude fibre the question may come up if litter and especially feathers are taken up as sources of structure and fibre. If those flocks have access to roughage and other sources of coarse crude fibre, eating of feathers and litter will decrease. A trial at the University of Hohenheim established that strains with high incidence of feather pecking ingest more feathers than strains with low incidence of feather pecking. Moreover, the authors discovered that feathers have the same effect in the intestinal tract as insoluble fibre, which is the acceleration of the intestinal transit period. A logical conclusion is that the animals ingest the feathers to overcome a deficiency of insoluble fibre.

#### **Fibre and Gut health:**

Crude fibre has no obvious nutritional value and all raw materials with increased content of crude fibre have less energy compared to corn. Because of this traditional fibre sources do not calculate by linear programming into high energy poultry feed. In the literature some information about feeding trials can be found where scientists tried to evaluate the benefits of increased content of crude fibre in layer nutrition together with sometimes excessive energy dilution of the feed. In those trials the benefits of crude fibre could be confirmed but performance was

compromised. This information has contributed to the bad reputation of fibre in layer diets even up to now. But most customers are facing the situation that the energy of the feed is a kind of fuel for nowadays modern layer birds. Due to this situation different kinds of fat and oil are standard raw materials nowadays as high dense energy raw materials and being an ideal solution to compensate the lower energy content of all the alternative raw materials compared to corn. countries like SCA where the alternative grains are being used together with added fat and oil it can be stated that 'fibre and fat are feeding well'. Feed with added fat and oil with a certain content of crude fat is additionally a tool of feeding for liver health and to counteract the incidence of the so called 'fatty liver syndrome'.

#### Fibre and Gizzard size:

For optimum feed intake during the onset of laying, gizzard size plays a very important role. This is important particularly during the heat stress period as well. One of the important roles of whole grains has been associated with their ability to stimulate

the activities of the gizzard. This, in turn, is believed to be related to physical structures of whole grains. The major chemical component important to the structural integrity of grains is the insoluble fiber, which makes up the main part of the cell wall architecture. Indeed, insoluble fiber itself has shown beneficial effects on nutrient digestion and gizzard activities. Recent research has shown that digesta passing through the gizzard have a remarkably consistent particle size distribution with the majority of particles being smaller than 40  $\mu$ m in size regardless of the original feed structure. The fact that gizzard contents have higher fiber content than the feed illustrates that fiber is harder to grind than other nutrients and thus is accumulated in the gizzard. For layers on floor and in modified cages, litter can be a significant source of insoluble fiber.

In addition, recent studies indicate that structural components of the feed or litter ingesta may play a role in preventing cannibalism among layers. If so, such components as wood shavings may also be an important enrichment of housing systems.

#### Performance and characteristics of the gizzard in birds fed wheat diets, 23 to 28 wk of age (Hetland et.al.2005 J. Appl. Poult. Res. 14:38–46)

	Wheat diet	Wheat diet + paper	Wheat diet + wood shavings	$\sqrt{\text{MSE}}^1$
Feed consumption excluding fiber, g/d	108	113	114	9.48
Egg production, g/d	55.6	58.6	57.7	4.37
Egg to feed, kg/kg	0.51	0.52	0.51	0.033
Empty gizzard, g/kg of live weight	8.9 <sup>b</sup>	9.9 <sup>ab</sup>	11.2 <sup>a</sup>	1.52
Gizzard contents, g/kg of live weight	3.3 <sup>b</sup>	3.6 <sup>b</sup>	5.1 <sup>a</sup>	1.33
Neutral detergent fiber in gizzard, g/kg of DM	250	269	341	100
Bile acids in gizzard, mg/g of DM	8.3	7.3	6.6	2.00
Total bile acids in gizzard, mg	15.1	12.3	20.6	7.39
Live weight, g	1,751	1,739	1,753	95

<sup>a,b</sup>Means in a row with different superscript are significantly different ( $P < 0.05$ ).

<sup>1</sup> $\sqrt{\text{MSE}}$  = Square root of mean square error in the analysis of variable.

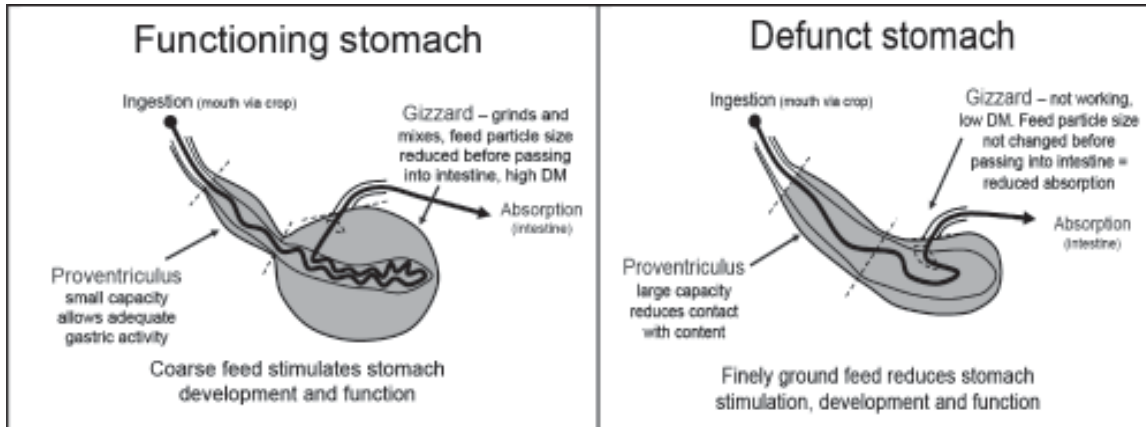
If the gizzard size is inadequate there will be a negative impact on performance as well. The aim should be, therefore, to make sure the gizzard at the end of the pullet stage is as big as possible. It is well established that particle size of feed has impact on the gizzard size.

**Relative weight of empty gizzard and gizzard contents in 36-wk-old birds fed pellets with whole or ground wheat or oats in conventional 3-hen cages or on litter floor**

*(Hetland et.al.2005 J. Appl. Poult. Res. 14:38–46)*

Item	Conventional cages				Litter floor				Pooled standard deviation
	GW	WW	GO	WO	GW	WW	GO	WO	
Empty gizzard, g/kg of live weight	11.7	11.6	13.3	16.0	18.4	17.9	15.6	16.8	2.43
Gizzard contents, g/kg of live weight	4.3	5.4	5.5	6.1	6.5	7.1	6.5	6.1	1.29

<sup>1</sup>GW = ground wheat; WW = whole wheat; GO = ground oats; WO = whole oats.



*Svihus.FQC 2012*



*Svihus .FQC 2012*

### **Fibre and layer Performances:**

In many university trials a positive impact of insoluble fibre on performance has been observed. The animals that received crude fibre in the formulation including some amount of crude fibre from the insoluble crude fibre showed increased hen day egg production (average production in the first 16 weeks) compared to the animals that received crude fibre only from traditional fibre sources. This demonstrates that the nature of the fibre has a major impact on performance. In poultry, insoluble dietary fiber has shown beneficial effects on starch digestion. Insoluble fiber increased total bile acids in the gizzard. That insoluble fiber decreases the nutrient concentration may also play a role by increasing digestive juices and substrate relationship. The current data and previous experiments show that the fiber level of the gizzard contents is about twice that of the feed. This means that fiber structures accumulate in the gizzard and that retention time of insoluble fiber is longer than for other nutrients. Fibers, such as cereal hulls, are very solid and can probably be retained for a long time in the gizzard. In contrast, whole cereal that mainly consist of starch granules and protein will be dissolved very fast in the acidic gastric fluid in the gizzard. Thus, the gizzard activity is more strongly stimulated by fiber structures compared with whole cereal structures. The gizzard has been found to play a major role for gastroduodenal reflux of digesta. An empty gizzard will not have feed stimuli and as such will not be able to regulate downstream digestive processes. This, once again, supports the hypothesis that birds may have a requirement for fiber for stimulation of the anterior digestive tract and that a functional gizzard needs contents with structural components.

### **Conclusions:**

Crude fibre in layers' feed may be a new and challenging topic for poultry nutritionists. An increased content of crude fibre in layers' feed never will harm any bird. Increased content of crude fibre should never dilute the energy content of the feed. When these preconditions are emphasized, a lot of layer flocks will show positive effects getting a diet with higher content of insoluble crude fibre. A lot of raw materials instead of corn and soya can be used for layer feed, as practical experience is showing in several countries.

The gizzard has an excellent ability to grind coarse components. Coarse particles are selectively retained in the gizzard until they are ground to a certain critical size. Structural components in the form of whole cereals and coarse water-insoluble fiber can improve feed use in birds fed highly concentrated diets. Formulations high in insoluble fibre result in better performance, a bigger gizzard, better intestinal health associated with drier litter, and in a reduced incidence of behavioural disorders like cannibalism. Lignocellulose products may be a good tool to use the benefits of insoluble crude fibre in layers' feed.

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# Control of internal parasites in organic poultry production

Keerthana, J and Prabhakaran, K.P

## INTRODUCTION

Organic livestock farming system is getting popular in many countries including India due to increased consumers' demand of organic products and environmental concerns due to increased demand for consumer's organic products, concerns about risk of chemical drug residues environmental effects and improved food quality in pasture based organic livestock farming have perhaps led consumers to organic food.

Organic poultry farming is most suitable for Indian conditions because of indigenous technical knowledge and practices followed by Indian farmers. The meat from poultry is more efficient to produce in terms of land use, feed and water use than other meat. It produces a lower environmental impact. Some consumers are also concerned about chemical residues in meat. The access to pasture demanded by animal welfare agents increases the susceptibility of an animal to parasites. Organic agriculture allows a restricted number of substances to be used for pest control. Therefore, it's necessary to prevent parasites in poultry farming. Organic systems seek to reduce external inputs and develop sustainable methods of production which balances output with high standards of animal welfare. Main goal is to eliminate anti parasitic dependence.

## INTERNAL PARASITES

Normally parasites are present in farms and it is impossible to eradicate them completely. When parasite numbers are too high for the host animals immune system to control, then we can able to see signs of disease, which includes weight loss, inappetite, depression, weakness and if not treated, leads to death.

Internal parasites are a potentially serious threat to health, welfare and productivity of organically managed livestock. The standards for organic production emphasis preventive control strategies based on grazing management, appropriate breeding and good nutrition.

Poultry can be infested by several species of intestinal worms, large round worms (Ascarids), cecal worms (Heterakis), Thread worms (Capillaria) and tapeworms (many species). Apart from that, many single celled organisms called protozoa such as coccidian, histomonads can be problematic in poultry. Mild infestation may not cause a problem. But large numbers

can cause a decrease in growth rate, general health and egg production, severe infestation may result in death.

## KEYS TO PREVENT ILLNESS FROM PARASITE

1. Preventive practices including animal selection, choosing species and types suitable for local conditions and resistant to prevailing diseases
2. Provide adequate nutrition
3. Establish housing, pasture management and sanitation practices to minimize occurrence of diseases and parasites

## RESTRICTIONS IN ORGANIC FARMING

Preventive use of chemically synthesized pharmaceuticals and antibiotics is not allowed in organic farming. The use of hormones, coccidiostats and other growth or production stimulants is not allowed either. Only a limited number of conventional treatments or treatment courses are allowed per animal per year, with the exception of compulsory treatments implied by law, vaccinations and anti-parasitic treatments. The withdrawal period after the use of a conventional treatment has to be doubled, but in some countries longer waiting times are compulsory.

## PRINCIPLES OF HEALTHCARE

- The farm area should have proper requirements and should focus on sanitation
- The poultry birds should be provided with quality feed and should be able to have regular open air runs to develop a natural immunological defense
- The main aim of treating a disease is to remove the pain and suffering from the animal
- Birds with diseases could probably treated with homeopathic or Ayurvedic products and not with antibiotics only under the supervision of a veterinarian
- Prevention of diseases or enhancing productivity through the use of allopathic drugs or antibiotics are not permitted

## TREATMENT OPTIONS

Organic producers are facing challenge to control parasites, since certified to be organic there are additional guidelines that have to be allowed. One of which is that routine parasiticides are not allowed. Alternative treatment



strategies are being used to assist in the control of parasites in organic poultry production.

- 1) OILS- several oils tested for effectiveness against protozoan parasites. The oils from lemon, rosemary, garlic, thyme, cinnamon and oregano have been used individually or in combinations.
- 2) MINERALS- Sulfur and diatomaceous earth, kaolin used in the treatment of external parasites like mite/ louse. But diatomaceous earth is used to treat both external and internal parasites with several products available for use by organic poultry farmers.
- 3) HERBS AND PLANTS- Garlic is useful for controlling external and internal parasites. Other plants like, wormwood, turmeric, aloes, black walnut bark, husk and shells of dandelions and nasturtiums. The plant citronella, pine needles, cedar chips and mint have been used for their repellent properties against external parasites.

#### PREVENTION

Preventive measures can help in the management of both external and internal parasites. Biosecurity is an essential component of preventing diseases and parasites on a farm. The plan for biosecurity includes, a) ways to restrict visitors and access to the farm b) cleaning and disinfection program c) all-in-all-out production system d) proper disposal of dead birds e) observation and periodic examination of the birds f) controlling rodents and wild birds g) record keeping is essential to prevent infestation in poultry farm.

Cleaning and disinfection- Not all products can be used to clean the organic farms. Some products used for cleaning and disinfection of poultry farms include, potassium and sodium soap, milk of lime, quick lime etc, alcohol, formaldehyde, natural plant essences, caustic potash, sodium carbonate, Hydrogen peroxide, water and steam.

Other practices like, providing proper nutrition, selecting animals and birds that shown resistance, pasture management and rotation with pastured and free range birds, reducing stress essential to reduce the infection.

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## Novus International files Methionine Antidumping Petitions with US Government

**SAINT CHARLES, MISSOURI** (29 July 2020) – Novus International, Inc. today filed antidumping petitions with the U.S. Department of Commerce and International Trade Commission. The petitions ask the agencies to investigate imports of methionine from Spain, France and Japan consistent with the World Trade Organization Antidumping Agreement.

Imports of methionine from the three countries are priced substantially lower than domestic producers' shipments. Illegal dumping of methionine in the United States at an artificially low price can hurt the U.S. agriculture industry.

"We believe fair and competitive business practices are integral to the health of our industry and are necessary to protect our customers and consumers everywhere," said Dan Meagher, president and CEO, Novus International, Inc. "Today we took steps to ensure those fair practices."

The volume of methionine imports into the United States from the three countries (Spain, France and Japan) increased by more than 200% from 2017 to 2019, and another 29% between the first quarter of 2019 and first quarter of 2020.

Access to domestically-produced methionine is critical for U.S. animal protein producers. Illegal dumping can result in the reduction or elimination of domestic production. The animal protein industry benefits from having domestic and foreign supply options available.

"The coronavirus pandemic has reminded us of the vulnerability of global supply chains and the impact on highly integrated industries, such as agriculture and food production, when disruptions occur," said Meagher. "We are simply asking the U.S. government to ensure Spain, France and Japan are abiding by international trade laws."

The government investigation will determine whether illegal dumping of imported methionine has occurred. The investigation is expected to take approximately 13 months. If the government determines importers did illegally dump foreign products, those importers may have to pay a duty on imports, which would be collected by the government as a tax.

The International Trade Commission is expected to make its preliminary determination by September 14, 2020. The U.S. Department of Commerce is expected to make its preliminary determinations and impose any remedial duties by January 5, 2021. These timelines may adjust depending on the course of the investigations.

###

**Novus International, Inc.** is headquartered in Saint Charles, Missouri, U.S.A. and serves customers in over 90 countries around the world. A global leader in scientifically developing, manufacturing and commercializing animal health and nutrition solutions for the agriculture industry, Novus's portfolio of over 160 products includes ALIMET® and MHA® feed supplements, MINTREX® chelated trace minerals, CIBENZA® enzyme feed additives, NEXT ENHANCE® feed additive, ACTIVATE® nutritional feed acid, ACIDOMIX® preservative premixture, SANTOQUIN® feed preservative, AGRADO® feed antioxidant, and many other specialty ingredients. Novus is privately owned by Mitsui & Co., Ltd. and Nippon Soda Co., Ltd. For more information, visit [www.novusint.com](http://www.novusint.com). ©2020 Novus International, Inc. All rights reserved.

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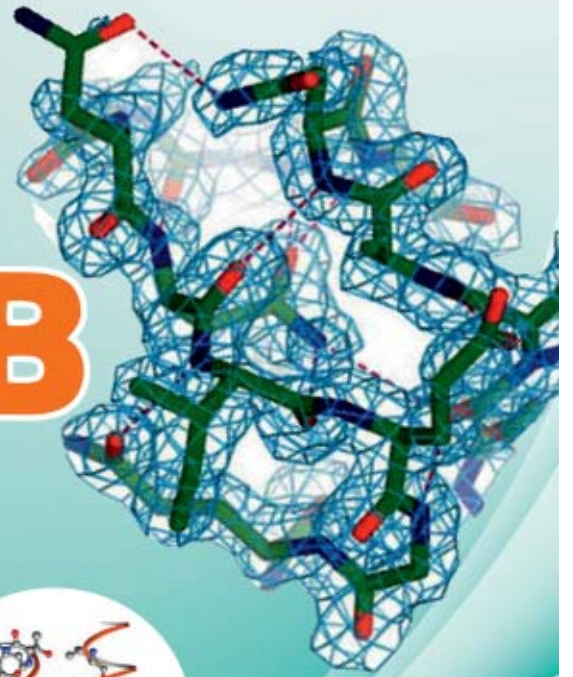
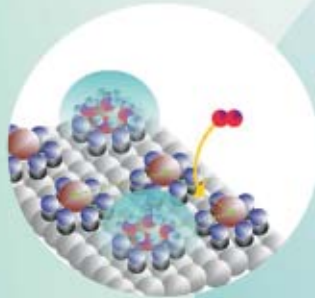
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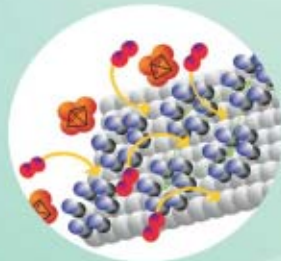
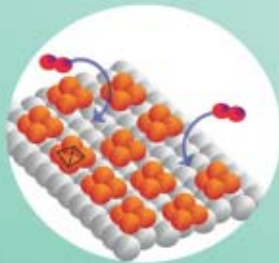
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## Novus: We Strive to be the Industry's Gut Health Leader

International feed additive company announces new structure, plans in animal agriculture industry

**SAINT CHARLES, MO** (10 July 2020) – When Dan Meagher returned to Novus International, Inc. to become CEO and president last year, he said it was the people that brought him back to the company after a six-year hiatus. Now he's putting his trust in the hands of his employees.

"Since my return to Novus in October I've been evaluating what the company needs to do to become the gut health leader I know that it can be," Meagher said.

This evaluation led to implementing a new corporate structure and establishing a regional operating model that aims to create a lean and agile company with decision-making closer to the customer. These changes are part of a multi-phase strategic plan called "Project Destiny."

Meagher also announced his new Executive Leadership Team to lead the company in its pursuit to become "a leader in gut health solutions for the sustainable production of protein through nutrition." Meagher said that in assembling the new structure and the leadership team, Novus remains resolute in its vision: "To help feed the world wholesome, affordable food and improve the quality of life."

Meagher said that by implementing the changes outlined in Project Destiny, the company will reduce complexity, simplify processes, as well as provide higher autonomy and accountability.

"We have a team of highly motivated and intelligent agriculture professionals working for us around the

world," Meagher said. "The Executive Leadership Team's goal is to give them the tools and the support that they need so they can make a difference with our customers. Under this new structure we are demonstrating the respect and trust that we have in our people."

He said that one example of this is in Novus's research and development department.

"We have a fantastic team of innovative scientists, researchers, and research partners, and we have a powerful foundation in the HMTBa molecule. All of this puts Novus in a position to develop new technologies and expand on our current solutions."

Methionine hydroxy analogue, or HMTBa [2-hydroxy 4-(methylthio) butanoic acid], is a form of methionine, an essential amino acid and necessary nutrient in commercial animal agriculture. Along with its methionine products, the versatility of the HMTBa molecule has allowed Novus to create a line of organic trace minerals, nutritional feed acids, and other solutions that positively affect animal's gut health and ultimately impact growth and development.

Novus is already well recognized for its organic trace minerals solutions and expertise and Meagher wants the company to also be the industry's go-to for gut health products and services.

"What happens in an animal's gut affects every part of its development," he said. "An animal with a healthy gut requires less intervention. A healthy gut



## The new Executive Leadership Team is:



**Dan Meagher**  
PRESIDENT & CEO



**David Dowell**  
EXECUTIVE VICE  
PRESIDENT AND CHIEF  
OPERATING OFFICER



**Maria Burt**  
VICE PRESIDENT  
AND CHIEF HUMAN  
RESOURCES OFFICER



**Randy Khalaf**  
EXECUTIVE VICE  
PRESIDENT AND CHIEF  
FINANCIAL OFFICER



**Carla Martin**  
VICE PRESIDENT,  
GENERAL COUNSEL AND  
CHIEF COMPLIANCE  
OFFICER



**Ed Galo**  
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OFFICER - AMERICAS



**Valbhav Nagpal**  
VICE PRESIDENT,  
CHIEF COMMERCIAL  
OFFICER - ASIA



**Uwe Ranft**  
VICE PRESIDENT,  
CHIEF COMMERCIAL  
OFFICER - EMEA

ultimately helps an animal meet its growth potential in a sustainable way, which is what all of our customers want.”

Meagher and his team will continue to implement the new strategic direction over the coming months.

“Through these changes we are improving our business and expanding our ability to serve our customers effectively and efficiently,” Meagher said.

“As a part of the animal agriculture industry, we have a commitment to help feed the world and these changes allow us to better fulfill that commitment.”

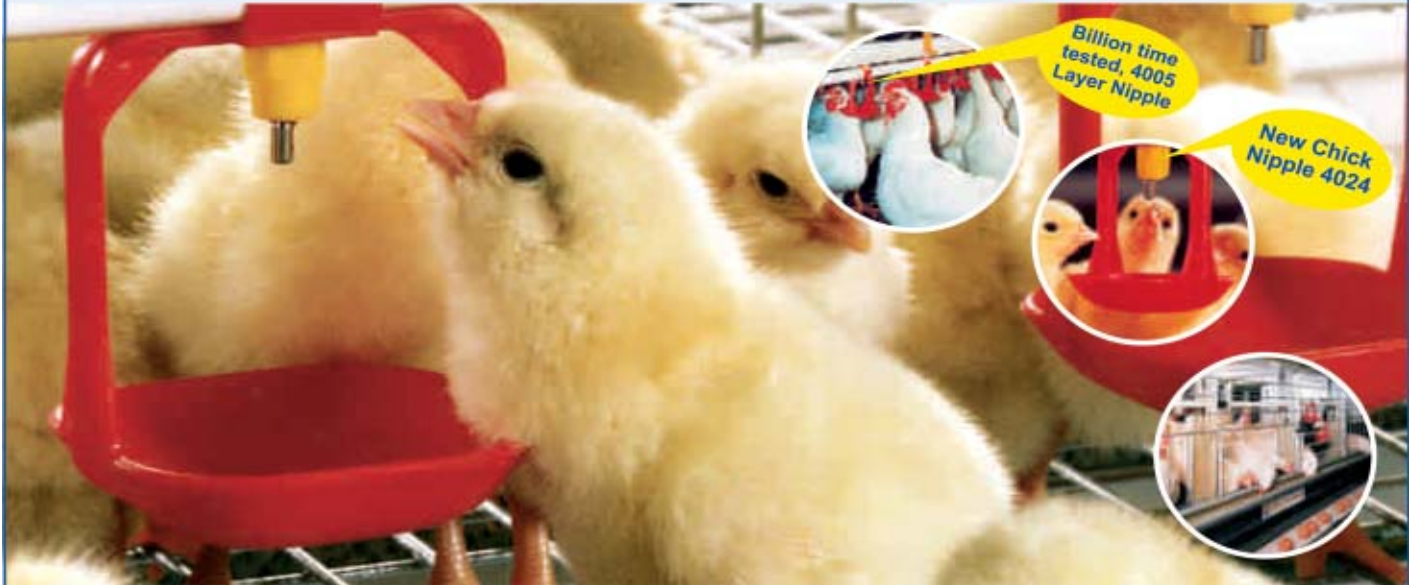
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# LUBING



THE ORIGINAL!



## Quality Products From Lubing For Your Poultry Farm



### Conveyor System

#### For Egg Transportation

The conveyor system is of crucial importance for egg farms of all sizes.

- Maximum operational safety and minimum maintenance.
- A unique construction system with elements designed to cope with any imaginable spot requirement (all kinds of curves, heights and distances can be achieved).
- Conveyor chain widths between 200 and 750 mm.
- Capacities: From 15,000 to over 65,000 eggs per hour.



### Watering System

#### For Chicks & layers In Cages

LUBING nipple system offers you the following advantages:

- A simple, reliable water supply.
- Constantly fresh and clean drinking water.
- Nearly no maintenance or cleaning
- Improved rearing results.
- Trouble free rearing of all birds
- The combination of nipple and drip cup ensures dry manure.

**BEWARE  
OF DUPLICATES.  
BUY ORIGINAL LUBING  
PRODUCTS ONLY**



### Top Climate System

The "LUBING,, Top-Climate-System is developed for effective humidifying, cooling and dust binding of the house air. It works according to the principle of the direct evaporative cooling.

The advantages at a glance:-

- Fast cooling in the house without any wetness.
- Effective dust binding influences positively the breath organs of animals
- Better feed conversion.
- Regular spread of temperature.
- To spray in medicated water (For prevention & therapy of respiratory diseases).

comarts

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Tal.: Mulshi, Dist.: Pune 411 042  
Telefax: +91 (20) 22952403/4/5/6,  
Cell: 09890996030, 09960635471

#### Branches:

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Beat the Bugs



# MAX O BAN PLUS

Don't let the microbial threats eat away your profits,  
Biosecure your farm with Rossari broad spectrum biocide



- Broad spectrum of action
- Water pipeline cleansing efficacy
- Ease of application with product safety
- No microbial resistance due to complex action
- Formulation offers enhanced antifungal activity
- Innovative formulation provides excellent activity even in presence of biofilms and organic matter

Presentation  
1 L & 5 L pack

## ROSSARI BIOTECH LIMITED

(An ISO 9001:2015 & 14001:2015 Certified Company)

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**VH NEWBRO-MN**  
NEWCASTLE DISEASE AND AVIAN INFECTIOUS  
BRONCHITIS VACCINE INACTIVATED



**Venworld**  
THE BEST IN ANIMAL HEALTHCARE

**Genotype XIII**

**INDIA**

**Novel NPR  
Variants**

2014  
Genotypic  
reclassification

1990's  
INTESTINAL  
FORM

1984-2014  
Most  
variable  
Genotype  
VII

1980  
Genotype  
VI

1960's  
NEPHROPATHOGENIC  
FORM

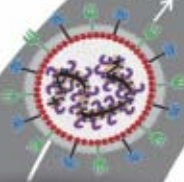
1950's  
REPRODUCTIVE  
FORM

1960-1980  
Genotype  
III, IV, IX  
and X

1926-1960  
Genotype  
I, II, IV

1930's  
RESPIRATORY  
FORM

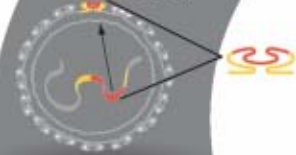
Fusion protein



NDV - 1926

**Diversity in antigenic types**

Spike protein



IBV - 1937

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Email: [ventri.biologicals@venkys.com](mailto:ventri.biologicals@venkys.com)

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