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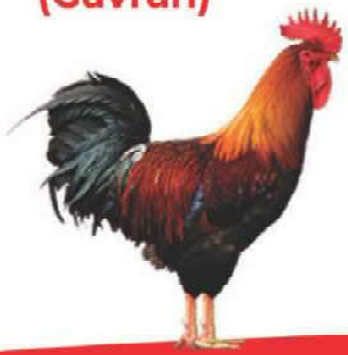

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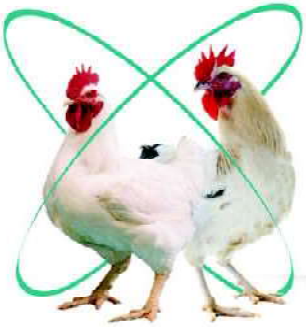

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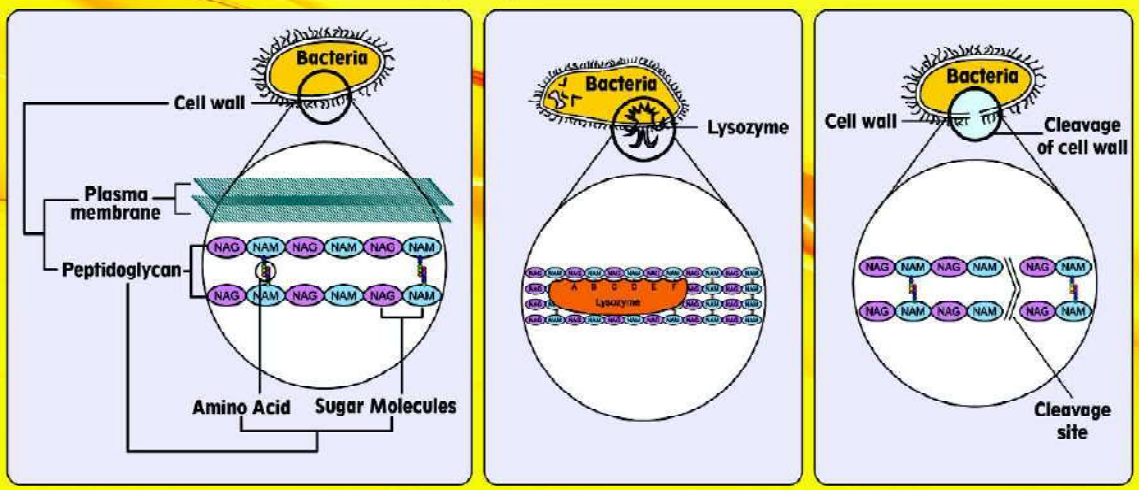


NAG : *N*-acetylglucosamine NAM :*N*-acetylmuramic acid

Available as

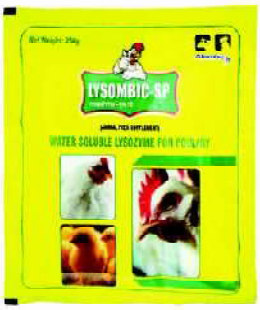
Pack : 1kg

LYSOMBIC - FS

Recommended usage:

For Broiler / Layer :
250 g / ton of feed

For Breeder :
500 g - 1kg / ton of feed



Pack : 250 gm

LYSOMBIC - SP

Recommended usage:

For prophylaxis:
1st week - 1g/L of water or 15 g/1000 chicks

2nd week onwards - 1g/3L of water

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INDEX OF ADVERTISEMENTS

Exploring Major Egg White Proteins of Hen's Origin

Simran Singh[1], Dibyendu Chakraborty[2*], Nazam Khan[3] and Harshit Verma[4]

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Introduction: Eggs are known for their exceptional dietary quality. A whole egg comprises of water (75%), proteins (12%), lipids (12%), carbohydrates and minerals. They are a reservoir of several protein (ovalbumin, ovotransferrin and lysozyme in egg white, as well as phosvitin, carotenoids and free aromatic amino acids in egg yolk), total fat, monounsaturated fatty acids, polyunsaturated fatty acids, cholesterol, choline, foliate, iron, calcium, phosphorus, selenium, zinc and vitamins A, B_2, B_6, B_{12}, D, E and K. Besides this, they also act as a source of the antioxidant carotenoids, lutein and zeaxanthin. Since egg protein contains all the essential amino acids required by the human body, it is considered as of high biological value. The major albumen proteins are ovalbumin (54%), ovotransferrin (14%), ovomucoid (11%), ovomucin (3.5%), lysozyme (3.5%), and globulins (8%) (Li-Chan et al., 1995).

Ovalbumin:

Ovoalbumin, belonging to the serpin superfamily, is the most abundant phosphoglycoprotein protein in egg white (López-Expósito et al., 2008) with a molecular weight of 45 KDa, comprising of 386 amino acids and an isoelectric point (pI) of 4.5. The N-terminal amino acid is acetylated glycine and the C-terminal is proline, thus making the amino acid configuration of ovalbumin is distinctive compared with other proteins. Also it is the only egg white protein which encompasses free sulfhydryl groups or thiol groups (Li-Chan and Kim, 2008). It contains the major serine protease inhibitors of human plasma which supervises enzymes of the coagulation, fibrinolytic, complement and kinin cascades, as well as proteins without any known inhibitory properties such as hormone binding globulins, angiotensinogen and ovalbumin. The gelling, foaming, and emulsifying properties of egg white are significantly dependent upon the ovalbumin (Mine, 2002)

Ovotransferrin:

Ovotransferrin is a neutral glycoprotein with a molecular weight of 77.7 kDa and a pI of about 6.1. It contains 686 amino acid residues and has 15 disulfide bridges. It is a disulfide-rich single-chain glycoprotein affiliated to the transferrin family enables it is to bind iron, and is thus known for antimicrobial, antifungal and antiviral activities (Wu & Acero, 2012). Ovotransferrin, endowed with both antiviral activity, against Marek's disease virus in chicken embryo fibroblasts (Giansanti et al., 2002), as well as antifungal activity, against species of Candida (Valenti et al., 1985). Xie et al. (2002) reported that ovotransferrin can act as an immunomodulator, modulating macrophage and heterophil functions in chickens. Earlier known as conalbumin, it was later renamed as ovotransferrin after findings that it can bind iron. One molecule of ovotransferrin can bind two iron molecules and transports iron in the body. Ovotransferrin has similar functions to lactoferrin found in milk possessing iron scavenging and iron delivery functions.

Ovomucoid:

Ovomucoid is a thermostable glycoprotein belonging to the Kazal family of protease inhibitors, with a molecular weight of 28 KDa and a pI of 4.1. It is well known as trypsin inhibitor with the capability of controlling microorganisms. Thus, acting as an antimicrobial agent for foods.

Ovomucin:

Ovomucin is a sulfated glycoprotein that subscribes to the gel-like structure of the thick white layer, forming flexible fibers. It constitutes of two subunits: α-ovomucin, with a molecular weight of 254 KDa, and β-ovomucin, with a molecular weight of 400–610 KDa. α-ovomucin, being homogenous, mainly encompasses acidic amino acids such as aspartic acid and glutamic acid, but no difference in ovomucin from thick egg white and thin egg white was found (Omana et al., 2010).

Lysozyme:

Lysozyme, which plays an important role in the natural defense mechanism, is an enzyme with a molecular weight of 14.3 KDa and a pI of 5.5 and accounts for 3.5% of total egg white having bacteriostatic, bacteriolytic and bacteriocidal activity. Possessing a single polypeptide chain with 129 amino acids, Lysozyme is a predominant enzyme that can hydrolyze the β-linkage between N-acetylneuraminic acid and N-acetylglucosamine in the bacterial cell wall (Huopalahti et al., 2007). It is also known as N-acetyl-muramic-hydrolase and consists of lysine and leucine in the N- and C-terminal, respectively. It has been shown to employ antiviral activity, mainly attributed to its charge, rather than its lytic ability (Losso et al., 2000). Lee-Huang et al. (1999) reported that chicken lysozyme also possessed activity against HIV type-1. It exhibits antimicrobial activity against organisms such as Bacillus stearothermophilus, Clostridium tyrobutyricum, Clostridium thermosaccharolyticum, Clostridium sporogenes and Bacillus spp. (Losso et al., 2000), as well as Enterococcus faecalis, Weissella viridescens (Gill and Holley, 2003), Brochothrix thermosphacta, Lactobaccilus sakei, Leuconostoc mesenteroides, Listeria monocytogenes (Gill and Holley, 2000), and Carnobacterium sp. 845 (Nattress et al., 2001) when used in conjunction with other compounds, such as nisin and EDTA. In addition to this, lysozyme also acts as an immune-modulating and immune-stimulating agent, strengthening immunoglobulin productivity, and synchronizing and reinstituting the immune responses in immune-depressed patients undergoing anti-cancer treatments (Sugahara et al., 2000), and as an anti-cancer agent, impeding tumor growth in a number of experimental tumors. Moreover negatively charged proteins such as ovomucin in egg white have a tendency to bind with Lysozyme (Wan et al., 2006).

Globulins:

Amongst the six globulin fractions present in egg white (are ovomacroglobulin, ovoglobulins G1, G2 and G3 and two other globulins) the two globulins were later classified as ovoinhibitors and ovoglobulin G1 was identified as lysozyme. Presently, the name ovoglobulin is assigned only to ovoglobulins G2 and G3, which have molecular weights of 36 and 45 kDa, with isoelectric points 5.5 and 5.8 respectively. The biological function of these proteins is related to the foaming capacity of egg white (Sugino et al., 1997).

Ovoinhibitor from Kazal family of protease inhibitors impedes serine proteinases such as trypsin and chymotrypsin and also bacterial and fungal proteinases (Mine and Kovacs-Nolan, 2004). These proteinases are involved in the modulation of numerous biological processes, and have been responsible for several diseases, including viral diseases, such as HIV (Maliar et al., 2002), and Alzheimer's (Schimmoller et al., 2002). Proteinase inhibitors, therefore, such as those from egg white, have significant potential for the treatment and prevention of proteinases-mediated diseases.

Ovomacroglobulin (also kown as ovostatin), the second largest egg glycoprotein after ovomucin, with a molecular weight of 760-900 kDa and is responsible to inhibit hemagglutination. The antimicrobial properties of ovomacroglobulin against Serratia marcescens and Pseudomonas aeruginosa have been observed both in vitro and in vivo. Besides this, it was also found to aggrandize periodontal wound healing in rats, by promoting

fibroblast growth, collagen deposition, and capillary formation in tissue (Ofuji et al., 1992).

Conclusion:

As the vital animal protein, eggs will continue to be an important part of our diets enclosing various biologically active substances with specific benefits for human health, and potential for medical, nutraceutical and food-fortification applications besides combating malnutrition thereby improving the sustainability of the egg industry.

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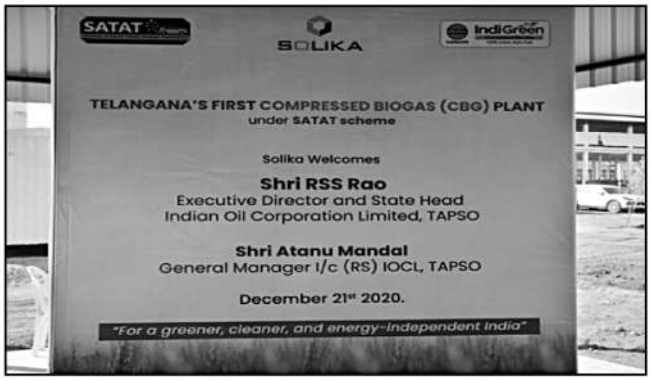
PRESS RELEASE

Solika Energy Pvt Ltd Inaugurates the Telangana State's first-ever Compressed Biogas Project Based on Poultry Litter



On Monday, December 21st, 2020, Shri RSS Rao, Executive Director of IOCL, TAPSO, along with Mr. Suresh Chitturi, IEC Chairman & Managing Director, Srinivasa Farms Group inaugurated a 2.4 Tonnes per day capacity Compressed Biogas (CBG) Project at Udityal Village, near Balanagar, Telangana. This project exclusively uses poultry litter as the raw material and is located next to a large commercial poultry farm with over 4.5 Lakh birds. All the raw material is collected from the poultry sheds. This is the first poultry litter-based CBG project in Telangana and Solika has built this project under the Sustainable Alternative Towards Affordable Transportation (SATAT) scheme by the Ministry of Petroleum and Natural Gas (MoPNG). The CBG produced in this project will be supplied to an IOCL outlet in Attapur, Hyderabad. Commercial sale at this outlet is expected to start from next month.

In addition to CBG, this plant will also generate around 15 Tonnes of good quality organic manure as a byproduct on a daily basis. Suresh Chitturi explained the importance of sustainable energy and how Solika plans to provide this to the local farming communities for their benefit to Shri RSS Rao, Executive Director - IOCL.

As per Mr. Suresh Chitturi, Solika has developed a unique process of ammonia reduction which results in sustained reuse of water making the biogas plant zero liquid discharge The unique process removes and reduces all impurities like feathers, stones, sand, and also reduces high ammonical nitrogen with a help of biological culture and at the same time providing an unique solution to the poultry community .

.Solika is also currently in the process of setting up the second CBG project in Telangana. This project is expected to have a CBG production capacity of 3.0 Tonnes per day.

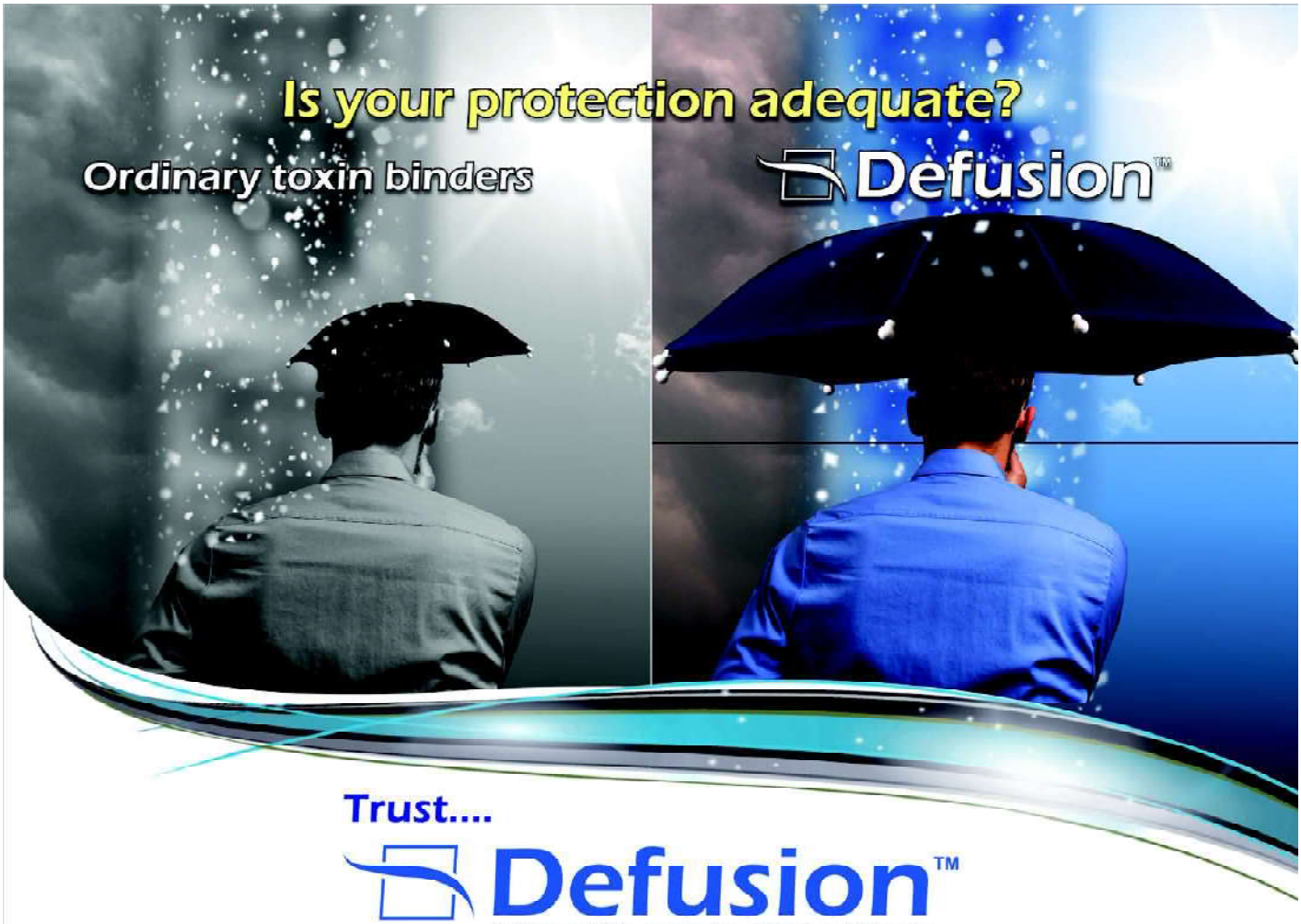
About Solika.

Solika Energy Pvt Ltd is a Compressed Biogas company backed by Srinivasa Hatcheries, one of the leading poultry companies in India and XEMX Projects. XEMX Projects is promoted by Himadeep Nallavadla. Solika believes that CBG will play an important role in India's energy future as it is able to help reduce fuel imports, provide a viable cleaner alternate fuel to vehicles, and provide additional sources of revenue to India's agricultural sector.

NATIONAL EGG CO-ORDINATION COMMITTEE

DAILY / MONTHLY EGG PRICES DECLARED BY NECC AND PREVAILING PRICES AT VARIOUS PRODUCTION CENTRES (PC) AND CONSUMPTION CENTERS (CC) DECEMBER 2020

Name Of Zone / Day	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	31	Average
NECC Prices																																
Ahmedabad	482	484	486	486	460	445	445	445	447	463	475	485	500	510	517	520	520	520	520	520	530	550	560	550	560	560	560	560	-	-	-	505.71
Ajmer	465	469	441	441	420	409	411	431	465	501	501	501	503	503	503	503	490	485	490	526	567	567	550	550	530	515	515	515	517	-	-	492.55
Barwala	463	463	440	440	423	423	423	427	455	483	483	490	496	496	496	496	496	496	496	521	550	550	550	550	550	515	515	515	517	-	-	490.28
Bengaluru (CC)	455	455	455	455	440	425	425	410	415	430	440	450	470	485	505	510	510	510	510	510	515	525	530	530	530	530	530	515	500	-	-	481.72
Brahmapur (OD)	448	452	452	452	452	432	417	417	417	425	440	457	473	479	484	487	487	487	487	487	495	505	510	516	520	520	520	520	520	-	-	474.41
Chennai (CC)	465	465	465	465	465	440	440	420	420	435	435	455	475	495	520	520	520	520	520	520	520	520	520	520	520	520	520	520	520	-	-	487.59
Chittoor	458	458	458	458	458	433	433	413	413	428	428	448	468	488	513	513	513	513	513	513	513	513	513	513	513	513	513	513	513	-	-	480.59
Delhi (CC)	485	485	485	485	472	460	455	455	481	511	511	511	521	521	521	521	521	521	521	545	571	571	571	571	571	560	560	545	535	-	-	518.72
E.Godavari	444	447	447	447	447	425	410	410	410	416	431	446	461	469	475	480	482	482	482	482	489	496	501	506	511	511	511	511	511	-	-	466.9
Hyderabad	437	440	440	425	405	405	395	395	411	421	435	451	462	471	475	478	478	478	478	485	500	511	516	519	519	519	495	495	485	-	-	462.9
Ludhiana	459	460	460	450	440	430	422	422	432	462	484	484	494	497	497	497	497	492	487	495	525	543	543	543	543	-	527	521	521	-	-	486.68
Mumbai (CC)	485	487	490	490	475	465	455	445	445	461	471	485	501	501	521	525	528	528	528	528	528	545	561	566	569	569	569	569	545	-	-	511.55
Muzaffurpur (CC)	510	510	510	500	486	486	476	476	480	514	537	538	543	548	548	548	548	543	548	562	581	605	605	605	595	590	571	567	567	-	-	541.28
Mysuru	455	455	455	455	440	425	425	410	415	432	445	455	475	487	507	512	512	512	512	512	515	525	530	530	530	530	530	515	500	-	-	482.79
Nagpur	455	455	455	450	440	420	420	410	400	400	460	490	500	500	510	510	490	490	490	490	490	535	550	550	550	530	515	515	515	-	-	482.24
Namakkal	440	440	440	440	420	420	400	400	400	415	415	440	440	480	480	480	480	480	480	480	490	490	490	510	510	510	510	490	490	-	-	460.69
Patna	505	505	505	486	476	476	462	476	495	504	524	543	548	552	548	543	538	533	543	562	586	595	600	600	586	571	562	562	562	-	-	536.14
Pune	485	487	490	490	480	470	460	450	450	465	475	485	501	511	521	525	525	525	525	525	535	550	565	565	565	565	565	550	540	-	-	511.9
Ranchi (CC)	514	514	514	500	490	486	476	476	480	510	529	538	548	552	552	552	548	543	548	557	581	595	605	605	595	590	581	571	571	-	-	542.1
Vijayawada	444	447	447	447	447	425	410	410	410	421	441	456	471	479	485	490	492	492	492	492	499	506	511	516	521	521	521	521	521	-	-	473.62
Vizag	437	439	441	441	441	441	441	441	441	441	441	441	451	460	465	470	472	472	472	472	480	500	500	505	510	510	510	510	510	-	-	467.41
W.Godavari	444	447	447	447	447	425	410	410	410	416	431	446	461	469	475	480	482	482	482	482	489	496	501	506	511	511	511	511	511	-	-	466.9
Warangal	439	442	442	427	407	407	397	397	413	423	437	453	464	473	477	480	480	480	480	487	502	513	518	521	521	521	497	497	487	-	-	464.9
Prevailing Prices																																
Allahabad (CC)	486	486	476	476	471	471	462	457	480	524	524	524	538	548	548	548	538	533	533	562	581	595	595	581	557	548	562	562	557	-	-	528.38
Bhopal	465	465	465	450	450	420	420	420	440	480	485	500	525	525	525	525	510	500	500	530	530	570	570	550	545	535	515	515	515	-	-	498.1
Hospet	420	420	420	420	405	390	390	375	380	395	405	415	435	450	470	475	475	475	475	475	480	490	495	495	495	495	495	480	465	-	-	446.72
Indore (CC)	470	470	470	450	450	430	430	430	460	500	500	520	530	530	530	510	520	520	520	530	555	555	555	555	540	530	530	515	530	-	-	504.66
Jabalpur	460	463	463	463	440	420	420	420	420	475	475	483	500	507	511	511	495	495	495	511	550	553	554	554	545	537	525	515	523	-	-	492.52
Kanpur (CC)	476	476	476	462	462	462	443	443	462	490	490	490	514	524	524	524	524	524	524	538	562	562	562	562	562	538	538	538	538	-	-	510
Kolkata (WB)	504	504	504	504	480	460	460	460	463	478	500	520	525	530	536	540	540	540	540	540	544	550	555	560	563	563	563	563	563	-	-	522.48
Luknow (CC)	510	510	510	500	500	500	490	490	490	523	537	543	543	543	543	543	543	543	543	560	593	626	626	626	617	607	583	583	583	-	-	548.55
Raipur	453	453	453	453	410	410	410	410	420	445	460	470	480	495	495	495	480	470	470	485	525	535	535	535	535	535	525	525	525	-	-	479.03
Surat	487	490	492	492	465	460	450	450	452	468	480	490	510	520	530	533	533	533	533	533	545	565	575	575	575	575	575	575	-	-	-	516.46
Varanasi (CC)	513	513	513	500	500	500	490	483	493	523	537	540	543	547	550	550	550	543	550	557	583	593	600	600	587	573	580	580	570	-	-	543.48



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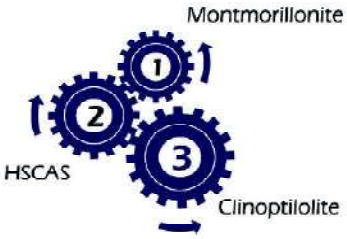

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Dietary sodium diformate (Acidomix® DF+) in broiler nutrition: a new approach for sustainable poultry production

Christian Lückstädt[1] and Sarah Mellor[2]

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Evidence of the development of antibiotic resistant strains of bacteria that are pathogenic to humans has mounted over recent decades; and the practice of using sub-therapeutic levels of antibiotics as growth promoters (AGP) in livestock production has been heavily implicated in this resistance. Worldwide, this connection has led to the erosion of consumer trust in agricultural practices that rely on this valuable medical resource. Increasingly, legislation is limiting their use. The latest news from Europe is that Denmark now imposes even stricter laws on antimicrobial use. This updated agreement, ratified by the Danish parliament, is an extension of previous agreements on animal welfare and the reduction of excessive antimicrobial use. "Stricter rules for the use of antimicrobials are part of strengthening the One-Health-perspective where animal health and human health are closely connected" (Ministry of Food, Agriculture and Fisheries, Denmark, 2012).

The shift from AGP to alternatives that began in Europe has spread rapidly, as exporting countries have had no choice but to comply. A number of alternative feed additives have been investigated. Among the new, tested compounds are acidifiers. These supplements include organic acids and their salts, like diformates. Potassium diformate, for instance, the potassium double-salt of formic acid, rapidly gained formal approval as the first legal alternative for in-feed antibiotics in Europe.

Formic acid and its salts are well known to improve productivity, acting against pathogens, which decreases the pressure on the animal's immune system. Thus, more nutrients will be available for productive functions such as growth or laying; whilst acting on the feed matrix to provide optimal conditions for digestive enzymes, particularly pepsin, releasing more nutrients from the feed. The double sodium salt of formic acid, while having the same antimicrobial properties as formic acid, has become more commonly used in poultry production, as it is easier to handle and does not negatively affect palatability, as can the pure acid.

Thus, several trials have been carried out in order to demonstrate the effectiveness of sodium diformate (Acidomix® DF+, Venky's) under various conditions world-wide.

First reports on the effect of sodium diformate in poultry nutrition appeared in 2009 (Lückstädt & Theobald) on the effect against Salmonella, Campylobacter and further gut microbiota. Later that year a paper entitled "Reducing broiler feed costs with diformate" was published by Swick & Lückstädt. Further, reports from Lückstädt, Eidelsburger and Theobald (2010) as well as Lückstädt & Theobald (2010) concentrated on the use of diformate in broilers at various dosages; and against positive and negative controls. The effect of the additive in turkey nutrition was confirmed in 2011 by Glawatz, Meyer and Lückstädt. Inclusion of the double salt into layer diets proved beneficial, especially on egg quality parameters and number of pathogens (Kühlmann *et al*., 2012). Finally, the anti-Salmonella effect of sodium diformate was confirmed by DEFRA in 2011/12.

The benefits of incorporating sodium diformate in broiler diets were as well tested recently under tropical conditions in a trial conducted at the research farm of the University of Agriculture and Forestry in Ho Chi Minh City, Vietnam. The acidifier was tested (0.1% DF+) in a commercial broiler diet, against the same diet containing either no acidifier (control group) or an antibiotic growth promoter (AGP: BMD-10 at 300g/t of feed). Feed and water were available *ad libitum*. The effects of DF+ on

Table 1: Performance-, dressing- and economic-parameters in broiler fed with or without sodium diformate (DF^+)

	Negative Control	DF^+ (1 kg/t)	AGP (300 g/t)
Number of birds	96	96	96
Final weight [kg]	2.264	2.324	2.345
Daily weight gain [g/d]	52.8	54.2	54.7
Daily feed intake [g/d]	109.4	103.1	110.6
FCR	2.07	1.90	2.02
Survival [%]	95.8	97.9	99.0
Breast ratio [%]	22.7	23.9	23.3
EBI	244	279	268
Cost of feed / 1kg gain*	0.72	0.66	0.71

***calculated in US-Dollar**

performance parameters of poultry (livestock viability, live weight, feed consumption and feed conversion), on dressing (breast meat ratio), as well as litter quality (water content, bacterial load) were examined. 288 day old birds (Cobb 500) were randomly selected and divided into 3 treatment groups with 96 chicks each. The diets were fed for 42 days. Performance data were measured at the end of the trial (Tab. 1).

Overall performance in the groups with DF^+ was increased, even when compared to the AGP-group. The addition of 0.1% sodium diformate under the circumstances of the trial resulted in an increase of 2.6% in weight gain, while the feed conversion rate was improved by 8.2%, compared to the negative control. Furthermore, this DF^+-inclusion was best according to the broiler index as well as being the most cost effective. Furthermore, birds fed with Acidomix® DF^+ had a numerical improvement when dressed. The breast meat ratio increased by more than 5% if compared to the negative control, while the improvement compared the AGP-group was still nearly 3%. One could speculate that this was caused by the improved protein digestibility, which is often reported in conjunction with the use of dietary acidifier.

Finally, the faecal quality and content of birds was examined. It could be stated that the litter quality - based on the moisture content, was significantly ($P<0.05$) improved in birds fed DF^+ (tested against the negative control). Moisture content in the faecal matter was reduced by 7% (in the 0.1% DF^+-dosage); while the AGP-group had only a reduction of 4% in the moisture content of faecal matter (moisture content of control litter was 57.2%). In conjunction with the improved quality of the litter is also the significantly reduced ($P<0.05$) level of *E.coli* in the faeces (Fig. 1), which is measured as MPN (Most Probable Number). If looked at the reduction rate, one could say that the use of dietary sodium diformate reduces the *E.coli* load in faeces by almost 97%!

In a further study conducted at the *All-Russian Scientific Research and Technological Institute of Poultry Breeding* (VNITIP) in Moscow the effects of Acidomix® DF^+ on performance parameters of poultry breeding (livestock viability, live weight, feed consumption, feed conversion ratio and digestibility of nutrients) were examined. The product was tested at a dosage of 0.1%. For comparison of alternative compounds an acid blend, consisting of mainly formic acid and lactic acid, was employed at the dosage of 0.3%. A negative control group received the basic diet without supplement. Each of the three treatment groups, 0.1% diformate, 0.3% acid-blend and negative control, consisted of 35 1- to 38-day-old birds. On day 38 after hatching livestock viability, live weight and feed conversion ratio were determined (Table 2).

Figure 1: *E.coli* numbers (MPN/g) in faeces of broiler fed with or without DF+

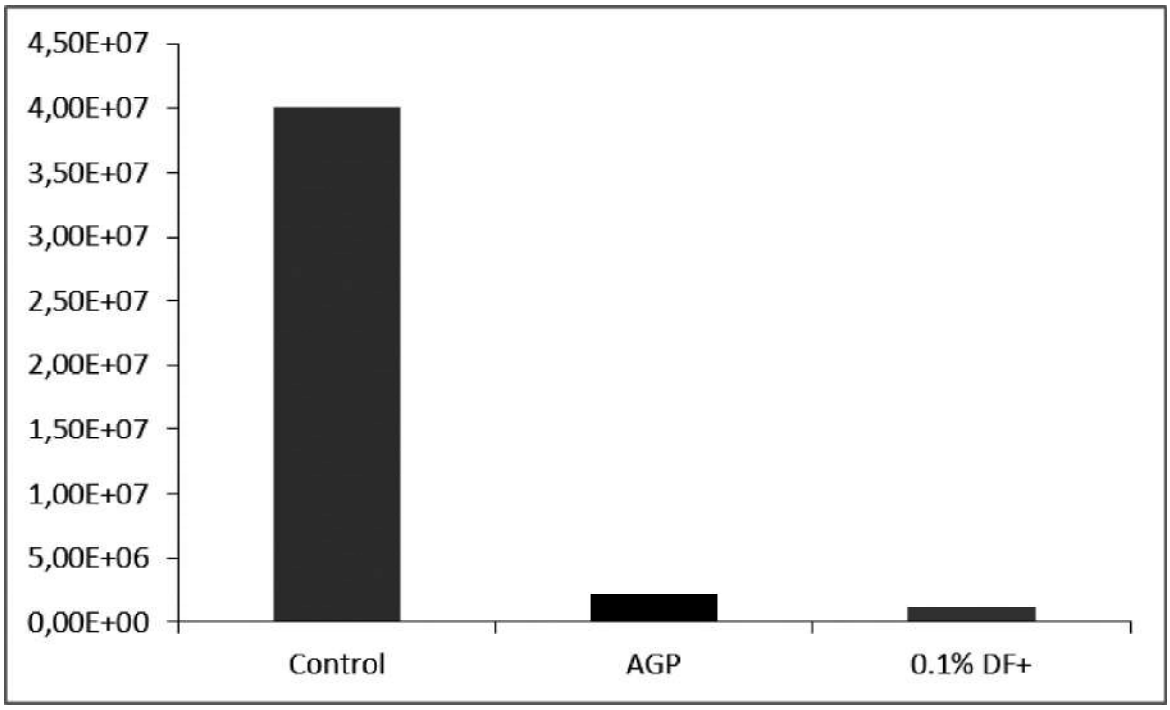

Table 2: Mean live weight and feed conversion ratio of broiler on day 38 (and % deviation from control group)

	Negative Control NC	DF+ (0.1%)	Acid blend (0.3%)
Live weight (kg)	1.937	2.044	2.021
Difference from NC (%)	-	+5.6	+4.4
FCR	1.77	1.65	1.66
Difference from NC (%)	-	-7.1	-5.4

There have been no reported mortalities during the study, which shows the quality of the trial location. Despite such a good hygienic status, addition of diformate was still found to enhance individual live weight. By the end of the experiment (day 38) broiler reached a weight gain surplus of 5.6% compared to the control group. Feed conversion ratio was also clearly improved by the use of sodium diformate (by 7.1% compared to negative control). In comparison, the triple acid-blend dosage led only to a reduction in feed conversion by 5.2%. The present findings lead to the conclusion that addition of DF+ considerably improves performance parameters of poultry by increasing live weight and improving feed conversion ratio, compared against a negative and a positive control.

Numerous reports have demonstrated how including sodium diformate in broiler diets has beneficial effects on performance by lowering bacterial pathogen load and improving nutrient digestibility, as reported above. These benefits are turned into economic returns, despite the perceived increase in feed cost of using additives. It is therefore recommended for the poultry producers to include dietary acidifiers, like Acidomix® DF+, into their broiler diets.

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An overview of caecal worm of poultry with special reference to *Heterakis gallinarum*

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The worldwide distributed *Heterakis gallinarum*, a non-migrating small ascarid, also known as caecal worm or smallest round worm of fowl is a highly prevalent but nonpathogenic parasite that thrives of various species of gallinaceous birds *viz*. fowl, guinea-fowl, pea-fowl, turkey, duck, goose and numerous other birds. This species is synonymously known as *H. papillosa*, *H. vesicularis* and *H. gallinae*. It has a direct lifecycle not requiring an intermediate host to complete development, and it is generally believed that poultry raised at high density on litter are at greatest risk for accumulating large numbers of nematode. This species typically only causes mild pathology that does not significantly affect performance of the birds. However, *H. gallinarum* is recognized as an economically important parasite by the poultry industry because its ovum as the vector for the protozoan parasite *Histomonas meleagridis*, the cause of histomonosis (blackhead disease) in poultry (Lund et al., 1975; Schmidt and Roberts, 2005). The protozoan can be transmitted in the eggs of *H. gallinarum* or in earthworms containing the L_2. The diagnosis of the caecal worm typically relies on both qualitative and quantitative faecal examination (Soulsby, 1982).

Besides *H. gallinarum*, other species is also found in the caecum of fowl in different part of the world. *H. brevispiculum*, found in caecum of chicken and guinea-fowl in South America has equal spicules barb near the tip of each. Similarly, worldwide distributed *H. isolonche* occurs in caecum of pheasant, quail and other gallinaceous birds. The male is 6-12 mm in length and female 9-12 mm. A perianal sucker is found in the asymmetrical spicules of one. In *H. gallinarum* all three parasitic part moults appear to occur in the caecal lumen, but in *H. isolonche* infection the hatched larvae enter the caecal mucosa, and developed maturity in nodules (Soulsby, 1982). The female (16-23 mm) *H. dispar* is longer than male (11-18 mm) having subequal spicules and both occur in caecum of goose and duck. *H. beramporia* (chicken in South and South-East Asia and Pacific Area), *H. indica* (Chicken in India), *H. linganensis* (Chicken in China), *H. meleagris* (turkey in China), *H. pavonis* (peafowl and pheasant in India and China) are some example of *Heterakis* species (Soulsby, 1982). The morphological features, life cycle, economic importance of *H. gallinarum* and pathogenesis and clinical symptoms caused by this species, epidemiology, diagnosis, treatment and their control of the disease are enlighten briefly in this article.

Morphology:

i) The male is 7-13mm long and female 10-15mm.

ii) Large lateral alae extending some distance down the sides of the body.

iii) The oesophagus has a strong posterior bulb containing the valvular apparatus.

iv) The tail of male is provided with large alae, a prominent circular pre-cloacal sucker, and 12 pairs of papillae and the spicules are unequal, the right being slender and 2 mm long, while left has broad alae and measures 0.65 – 0.7 mm.

v) Eggs (65-80x35-46µm) have thick, smooth shells and are unsegmented when laid.

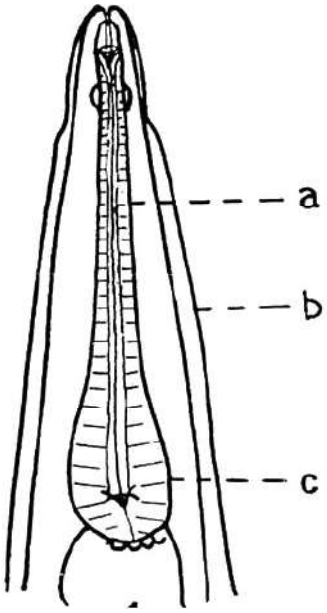

Fig 1: Anterior end a) oesophagus b) lateral alae, c) bulbous posterior part of oesophagus (*Source*: Soulsby, 1982)

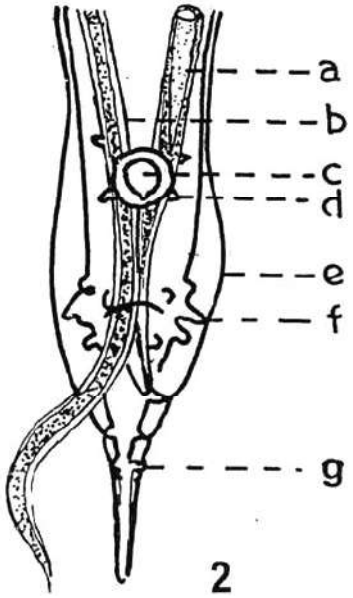

Fig 2: Posterior end of male a) left spicule, b)right spicule, c) pre-cloacal sucker, d) papilla, e) caudal alae, f) adanal papilla, g) post-cloacal papilla (*Source*: Soulsby, 1982)

Life cycle:

The eggs are come out along with the faeces of poultry which appear in contact with the temperature and moisture and develop to infective L_2 in 14 days at 27 °C but usually longer and may take several weeks at lower temperature (Soulsby, 1982). When the host swallows an infective egg containing L_2 the larvae hatches in the gizzard or duodenum or intestine after one or two hours and passed to the caecum. Their development is completed in the lumen, but some may enter the mucosa and remain for years without further development. The prepatent time is 24–30 days (Soulsby, 1982; Urquhart et al. 1987). Up to about the fourth day the young worms are rather closely associated with caecal mucosa and some injury to the glandular epithelium may occur. L_2 spend 2 to 5 days in the glandular epithelium before continuing their development in the lumen. They moult to L_3 on 6th day after infection, the L_4 on the 10th day and L_5 on 15th day. The first eggs are passed in the faeces of the bird after 24-30 days. Earthworms and houseflies are considered paratenic hosts or transport host, as they can ingest the egg in faeces and a juvenile may hatch in tissues, which stays dormant until eaten by birds (Permin and Hansen, 1998). When the eggs are ingested by the earthworm and simply passing through the gut and hatched out to larvae further develop to L_2 in the tissues. The birds get infection by ingestion of infected earthworm with L_2 (Soulsby, 1982; Urquhart et al. 1987).

Pathogenesis and clinical signs:

Primary infections are usually not apparent. Secondary infections are characterized by the formation of nodules in the caecum and the submucosa of the caecum (Pattison et al., 2003). The direct effects of *H. gallinarum* are slight and only in heavy infections may there be thickening of caecal mucosa with a number of petechial haemorrhages on the surface. During heavy infections, intestinal walls may thicken and exhibit marked inflammation (Pattison et al., 2003). Even so, no marked ill effects are ascribed to infection. *H. gallinarum* infection is itself is mildly pathogenic. However, *H. gallinarum* plays the role of carrier in

the lifecycle of *H. meleagridis* the causal pathogen of enterohepatitis "blackhead" of turkeys (Soulsby, 1982). *H. meleagridis* stays viable while inside the egg of *H. gallinarum* (Pattison et al., 2007). The congestion, thickening, petichial haemorrhages of the mucosa, intussusceptions and nodules in the caecal wall are main pathological changes in heavy infections of heterakiosis in pheasants. In addition there is chronic diffuse typhlitis, haemosiderosis, granulomas with necrotic centre in the submucosa and leiomyomas in the submucosa, muscular and serosa associated with immature *H. gallinarum* (Menezes et al., 2003). In egg-laying hens, heavy infection significantly reduces egg production (Pattison et al., 2003).

With *H. isolonche*, on the other hand, marked lesions may be produced in the caecum of the pheasant (Soulsby, 1982). These consist of a nodular typhlitis which leads to diarrhoea, wasting, emaciation and death. All stages of *H. isolonche* may be found in the lesions. *H. beramporia* may also be found in nodules in the caeca. *H. isolonche* of game birds is in itself pathogenic, causing a severe inflammation of the caeca with nodules projecting from both peritoneal and mucosal surfaces. These cause diarrhoea with progressive emaciation and there may be mortality in heavy infected flocks (Soulsby, 1982).

Significant importance:

The principal economic importance of *H. gallinarum* lies its role as a carrier of *Histomonas meleagridis*, the causal agent of 'blackhead' (enterohepatitis) of turkeys (Soulsby, 1982; Urquhart et al., 1987). The primary infection of histomonosis occurs in the caecum, and under the natural conditions the main route of infection is by the by the ingestion of the embryonated eggs of *H. gallinarum*.

Epidemiology:

The world wide geographically distributed *H. gallinarum* is commonly found in chickens, domesticated turkeys, and many other species of fowl, primarily of poultry. Their eggs are found to live for years in soil making it difficult to eliminate *H. gallinarum* from a domestic flock. The eggs of *H. gallinarum* are very resistant and may remain viable in the soil for months (Urquhart et al., 1987). Earthworms may ingest the eggs of *H. gallinarum* and contributes to the cause of infections in poultry. Although the eggs are themselves infective, they can develop further into a second infective larval stage. This development occurs around 27 °C and takes 2–4 weeks (Kaufmann, 1996). *H. gallinarum* is widespread in most poultry flock and is of little pathogenic significance in itself, but is of great importance in the epidemiology of *H. meleagridis*.

Diagnosis:

H. gallinarum infection is usually only diagnosed by the finding of eggs in faeces or the presence of worms at necropsy (Soulsby, 1982; Urquhart et al., 1987). Caecal faeces have to be examined and the eggs must be differentiated from those of *Ascardia galli* and other related worms. *H. isolonche* infection is diagnosed at necropsy by the finding of caecal nodules containing adult worms, and if necessary, confirmed microscopically by examination of the spicules.

Treatment:

Treating and preventing *H. gallinarum* infection is made difficult due to the low efficacy of anthelmintics for eradicating *H. gallinarum* from infected birds and disinfectants for destroying *H. gallinarum* ova on contaminated farms. However, phenothiazine is effective at a dose of 1 g per bird (one part of phenothiazine to 60 of feed, given for 6 hours after an overnight fast). Phenothiazine and piperazine mixture @ 1g of (7:1) in feed is effective (90%) but single piperazine is less effective. Hygromycin B as a 0.25% mix with feed is highly effective. Mebendazole is effective at dose of 2 g in 28 kg feed. Tetramisole is effective at 10% solution in drinking water. Haloxon is given @ 30 g per 50 kg of feed (this drug is toxic for geese). The strict sanitation of poultry houses and yards are essential.

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Biosecurity: An Indispensable Measure for Poultry Farming

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In India organized poultry farming was first advocated in 2nd five year plan in 1957 after which organized poultry farming started. In 1960s hybrid layer and broiler strains were introduced in Indian market. From then various improved strains of layers and broilers has been developed by government institutes like Central poultry breeding farms, ICAR etc. and private companies like Venky's and Suguna etc. Now in India total egg production per year have reached 103.32 billion with per capita egg availability of 79 eggs per annum and total poultry meat production is 4.06 million tonnes. Andhra Pradesh, Tamil Nadu, Telangana, west Bengal and Haryana are the major contributing states in total egg production. For increasing the profits of poultry farmers the major concerns are egg production period in case of layer birds and body weight gain with minimum requirement of feed in case of broiler birds. One factors that can affect both of these category birds are diseases which cause deterioration of health of bird and simultaneously decrease the performance of the bird. Among all the disease major loss occur due to the diseases that affect whole of the flock in short period of time for e.g. Bird Flu and Fowl Pox etc. the main reason behind the spreads of these kind of disease is the negligence in following various biosecurity measures in the farm which causes spread of diseases from one farm to other farms.

What is Biosecurity?

Biosecurity simply means safety of living beings. It is a programme which includes number of measures to prevent exposure of harmful and disease causing pathogen to poultry birds from one farm to other farms. Broadly it includes sanitation, vaccination, isolation of birds and serological examination of birds for various diseases and air quality of vicinity of birds etc. which helps in preventing and controlling entry of pathogens in and around the farm. It is basically a hygiene procedure which keep farms disease free. It as a defensive health plan of the farm.

As day by day poultry farms are moving towards intensive farming chance of spreads of diseases increases due to more numbers of birds kept in limited space. Which make it essential to fully implement the biosecurity measures which helps in exclude the disease causing pathogen from the environment of the farm. Biosecurity, vaccination as well as medication and good management at farm are the basics of a perfect disease control plan. Biosecurity is the cheapest of all of these measures and play a key role in the disease controlling.

Levels of Biosecurity

Biosecurity can be divided into three level on basis of implementation in farm day to day activities:

1. Conceptual biosecurity- It includes the biosecurity measures that have to be taken even before establishment of a poultry farm. The farm should be located at isolated area, at least 3 km away from any poultry farm nearby. In cases of a poultry breeder farm, it should be away from road that are used by other commercial poultry farms nearby to prevent transfer of disease from that farm into breeder flock. There should be enough distance between various facilities of own farm like hatchery, grower farm, layer farm, broiler farm, breeder farm and feed mills etc.

2. Structural biosecurity- it includes biosecurity measures related to structure of the farm in which birds are kept. The farm perimeter should be well fenced to prevent entry of unwanted visitors at farm. The water facility of the farm should be regularly tested for minerals, disease causing bacteria and chemical contaminations etc. At the entry of the farm proper arrangements for sanitization of

vehicles entering in the farm should be done. All feed for birds should be stored at raised platforms to avoid rodents. There should be all-weather roads within the farm to ease the cleaning of vehicles and foot wear to prevent spreading of microbes. There should be a separate facility away from farm for safe scientific disposal of dead birds. The facility where birds are kept at any stage of lifecycle should be raised enough to protect birds from rodent, wild birds and in floods born areas. Feed, litter and equipment should be stored away from live birds to prevent any contamination from diseased bird to feed or litter stored. A three metre boundary of land around the building must be kept free of all vegetation to prevent rodent and wild life activity. There should be facility of quarantine in case of new bird entering in the flock.

3. Operational biosecurity- It includes biosecurity measures that should be done during day to day operations of a feed mills, hatcheries, breeding and grow-out facilities in poultry farm. After selling of all the birds of flock and before entering of new flock in the same facility, proper decontamination and disinfection of all the equipment, houses, feed mills and litter etc. should be done. In breeder farms, all visitors and workers require to shower and use clean farm clothes to prevent cross contamination between them. Proper records of workers and persons visiting the farm should be done. Workers in different facilities should not be mixed or exchanged to prevent spread of disease from on flock to other in own farm. No vehicle or outsider should be allowed in the farm after settling of new flock in the farm until the disposal of that flock. In commercial broiler farming units minimum 2 weeks interval is recommended between two flocks. There should be effective pest control programme using all biological, chemical and mechanical means. In case of small scale layer farm, follow all-in-all-out system. If it is not possible, chicks should be obtained from a hatchery having chicks free from any disease transmitted through its mother. Routine disease monitoring procedures like post mortem examination and periodic serum antibody assay to determine immune status of the flock should be carried out. All birds should be closely observed for any visible symptoms of illness and unhealthy birds should be immediately separated from the flock and then treated. Regular culling of unhealthy, unproductive and diseased birds should be carried out in the farm.

Farm Management strategies under Biosecurity

Main goal of biosecurity of poultry farm is to avoid introduction of disease causing pathogens during routine management operations of farm. For achieving this goal, few major section of management activities of poultry farm are deal with more care which are following:

- **Housing –** It is advisable that birds related to different age groups and reared for different purposes should be housed separately in different housing facility. As immunity of young birds and old birds are less strong than mature birds so some disease conditions which may not be apparent in mature birds may cause disease in weak immune birds. This strategy of separate housing prevent such incidences. Usually all birds of same age group are kept together and only after their disposal new batch comes in farm. Ensure that chicks are healthy with the normal weight range and received from a hatchery where adequate preventive care is taken for breeder birds to guard against mycoplasmosis, salmonellosis and infectious bursal disease.

- **Nutrition –** A good quality feed with balanced nutrients prepared according to the age group, purpose and metabolic needs of birds should be given. Usually grinded and proper mixed feed are given to birds to avoid selective eating by birds. Nutritious feed helps in improving immune system by provided essential nutrients. Addition of coccidiostats, and vitamin and mineral supplements are done to prevent parasitic disease like coccidiosis etc. Water is one of the source of water born disease of poultry. So good quality contamination and pathogen free water should be

provided to birds for better immune system. Chlorination of water is one of the best and cheapest method to get rid of micro-organisms. By providing sanitized water to the birds, the chance of water-borne infections is reduced and the cost of medication is saved as well as it increases growth of birds and egg production efficiency. The pH of water should be 6.8- 7.5 and there should be no coliform bacteria in water.

• **Dead bird disposal –** Dead birds are major source of infection for pen-mates and other birds on the farm for various diseases. These dead birds release their infectious material into the surrounding environment which act as reservoir for diseases. So dead birds should be removed as early as possible. Throwing of dead birds on nearby open ground or pile of manure is usual practice by farmers which is very dangerous. As vultures, dogs and flies feed on these infectious carcass and become source of infection for different species. This practice of throwing dead birds also cause water, soil and air pollution so this practice should be stopped immediately. Dead birds should be removed from farm immediately and proper post mortem should be performed for reason of death. Then it should be disposed by methods such as burying, pit disposal, incineration, septic tank disposal, or composting using proper gloves, polythene bags for birds and other biosecurity measures.

• **Litter and Manure –** In deep litter system of rearing birds, litter should be changed within 10-15 days. Caking of litter should be avoid as it causes formation of ammonia gas which cause irritation in respiratory tract of the bird. Manure should be removed time to time as it the major source of ammonia.

• **Disinfection –** It is the process of destroying pathogenic bacteria and microbes from non-living objects. Disinfection should be practices on regular intervals for better health of birds. For all the non-living objects like equipment, feeder, drinkers, buildings and footwear disinfection should be performed. Phenol, cresol, chlorine compounds and iodophors are most commonly used disinfectant in poultry farms. For fumigation purpose liquid formalin at 5 percent level, or formaldehyde gas can be used. For washed equipment sun-drying and for cement surfaces dry heat like flame can be used. For fungal disinfection copper sulphate should be used in poultry farms.

• **Pest control –** Pest are major problem in poultry farms. So proper pest control programme should be prepared for poultry farms. Piles of unused equipment and empty gunny bags should be removed as these serve as breeding site for rodents and other pests. Unused feed should be removed daily and feed should be stored at well ventilated and rodent proof sites. Rodent traps and rodenticides should be used according to level of severity of rodent problem. Rodenticides should be used at night according to specifications. Insects also cause major problems to birds. They usually irritate the birds as well as they serve as transporter of various infectious pathogens. Which causes stress to the bird and results in reduced egg production especially where cage rearing is practised. To prevent this, stagnant water should be removed from vicinity of bird cage and proper drainage system for waste water should be used. Insecticides should be used according to severity of problem with recommended guidelines. Surrounding of the farm should be kept clean and free of insect flourishing vegetation.

Conclusion

In today's scenario where COVID-19 becomes a pandemic and spread in the whole world due to not following proper biosecurity measures for humans. This kind of condition is seen in the past in poultry world with Fowl Pox and Bird Flu like diseases which shows us the importance of following biosecurity measures in poultry farms. Lacs of birds have to be destroyed due to these diseases which causes huge losses to farmers. So these biosecurity measures are extremely important for profitable poultry farming and prevention is better than cure.


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Ascites in Chickens - Water Belly

Water belly in broiler flocks is a leading cause of mortality and whole carcass condemnations

Ascites in chickens, commonly referred to as water belly, represents a spectrum of physiological and metabolic changes leading to the excess accumulation of fluid in abdominal cavity. These changes occur in response to a number of dietary, environmental and genetic factors.

Definition

The term "ascites" actually refers to the fluid accumulation in abdominal cavity: so-called "water belly". The disease is more scientifically known as pulmonary hypertension syndrome. Ascites is most commonly diagnosed at 4 to 5 weeks of age. Total mortality due to ascites is higher in the male parent lines, which have the capability of faster growth and higher muscle deposition compared to the female lines (Dewil et al., 1996).

Pathology

The pathology is associated with abnormally high blood pressure between the heart and lungs (pulmonary hypertension) leading to heart failure, increased blood pressure in the veins, and excessive build-up of fluid in the liver which leaks into body cavity (Maxwell, 1990).

Figure 1. Dilated abdomen, or water belly, caused by ascites in chickens

Characteristic symptoms of ascites in chickens

- Poor bird development
- Dilated abdomen ("water belly")
- Dyspnoea (panting, accompanied with gurgling sounds, even in the absence of apparent heat stress)
- Possible cyanosis (a blue discolouration of the skin, especially around the comb and wattles and muscle tissue - Figure 1)

Etiology

The etiology of ascites is very conflicting. Usually genetics have been blamed for water belly in poultry. However, the breeding companies have improved genetic resistance of the stock to the ascites.

A combination of factors leads to ascites:

- Environment: ambient temperatures, high altitudes, stock density, air quality
- Nutrition: diet density, feeding type
- Hygiene: feed, environment
- Genetic events

Mold

Another pathogenic agent is a mold, *Aspergillus fumigates*, occasionally present in the environment of all poultry. Disease caused by this mold, so-called "brooder pneumonia", forms mould colonies in the lungs, and produces hard nodular areas leading to air sac infection and subsequently to the development of ascites.

Endotoxins

A considerable number of ascites syndrome in broiler flocks is caused by microorganisms. Most of the Gram-negative bacteria (*E. coli, Salmonella sp., Campylobacter*) are considered pathogenic because of their lipopolysaccharide (LPS) layer.

Some studies have shown that LPS triggers pulmonary vasoconstriction leading to ascites (pulmonary hypertension) in broilers (Chapman et al., 2005). Airborne LPS is ubiquitous in the environment of broilers, and is positively related to the amount of organic dust in poultry houses (Zucker et al., 2000).

For example, respiratory exposure to *E. coli* can amplify the incidence of ascites five-fold in broilers. It is known that *Salmonella typhiumurium* may cause up to 79% mortality in one week old chickens. However, in some studies lesions of salmonellosis were reported for 4 to 6 week old broilers with *E. coli* co-infection consequentially leading to ascites (Ganapathy et al., 2000).

Treatment and prevention: Firstly, it is important to understand the underlying causes of an ascites occurrence on a poultry farm. In the case of ascites caused by genetics, feed restriction might reduce the effect of the disease. Slower growing birds have reduced oxygen needs allowing the cardiopulmonary organs (heart and lungs) to keep up with oxygen demands of the birds.

However, reducing feed intake decreases **broiler growth performance**. Feed restriction is only of economic benefit when the incidence of ascites is very severe.

In the case of ascites caused by microorganisms, recent studies investigating the effect of feed supplementation with acidifiers have shown promising results. Of course, optimal management practices are also very important for reducing the problem of ascites and maximising performance of broilers.

Improvements in growth performance and decreases in mortality rates, as well as benefits in alleviating ascites in chickens have been observed in recent trials with BIOMIN's acidifier product Biotronic® SE.

Trial design

Nine hundred day-old Cobb 500 male broiler chicks were divided into three groups. The birds were fed a corn-soybean meal diet. The Negative control group diet contained no feed additives, whereas the diet of the Positive control group was supplemented with an antibiotic growth promoter (AGP), and the trial group was supplemented with the acidifier Biotronic® SE (BIOMIN GmbH) at an inclusion rate of 1.5 kg/t feed. The duration of the trial was 46 days. The weight of the birds was recorded on days 14, 35, 42 and 46. Mortality and observations of the birds for abnormalities (diarrhea, depression, immobility) were carried out daily.

Farm management

The trial was conducted on a commercial broiler farm. The mean external ambient temperature was 18°C, and the humidity was 40%. The birds were vaccinated against Newcastle, Infectious Bronchitis and Infectious Bursal disease.

Ascites incidence

Ascites incidence was characterized by clinical signs (panting, gurgling sounds, cyanotic combs and wattles, excessive abdominal fluid accumulation) and mortality rates. The incidence of ascites in chickens was confirmed by postmortem examination.

Results: For the initial 42 days, the broilers did not show any obvious clinical signs of ascites, even though on Day 35 mortality rates were recorded in the Negative control, Positive control and Biotronic® SE groups as 2.04, 3.09 and 2.39% respectively (Table 1). On Day 42 an outbreak of ascites was observed on the broiler farm with typical ascitic symptoms such as gasping, cyanotic combs and wattles, depression, extended abdomens, and increased mortality rates up to 7.53, 5.26 and 3.81% in the Negative control, Positive control and Biotronic® SE groups respectively. In the Biotronic® SE group, the mortality rate increased 37.27% over the mortality rate prior to the ascites outbreak, compared to 72.90 and 41.25% respectively in the Negative control and Positive control groups.

Table 1. Effect of Biotronic® SE on body weight and mortality rate in broilers

	Negative control group	Positive control group	Biotronic® SE group
Days 14			
No. of chickens	300	299	299
Final BW, g	246.0	238.0	241.0
Mortality rates, %	0.00	0.33	0.33
Days 35			
No. of chickens	294	291	293
Final BW, g	1104.0	1301.0	1288.0
Mortality rates, %	2.04	3.09	2.39
Days 42			
No. of chickens	279	285	289
Final BW, g	1708.0	1805.0	1813.0
Mortality rates, %	7.53	5.26	3.81
Days 46			
No. of chickens	260	279	281
Final BW, g	1835.0	2019.0	2066.0
Mortality rates, %	15.39	7.53	6.76

Necropsy of the dead birds revealed the characteristic lesions of ascites. Amber or clear fluid (lymph) was found in the abdominal cavity, hearts were enlarged with fluid in the pericardium (the sac surrounding the heart), livers were swollen and congested and sometimes with fibrin adhered to their surface, and lungs were pale or grayish.

By the end of the week 7 the mortality in the Negative control and Positive control groups reached 15.39% and 7.53% respectively whereas the group fed diets supplemented with Biotronic® SE recorded the lowest mortality rate at 6.76%.

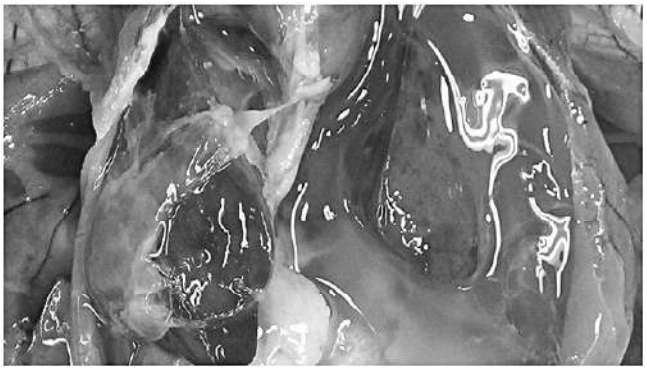


Figure 2. Opened abdominal cavity of an ascetic broiler chicken showing the abundance of ascetic fluid

Discussion

This trial result demonstrated that diet supplementation with the acidifier Biotronic® SE represents a solution to alleviate the effect of ascites on broiler farms. In this study, ascites could be attributed to a microbial cause, most probably *Salmonella sp.* or *E. coli* and some other co-infection agents.

The genetic cause of ascites herein might be excluded, since the growth of the broilers was much lower compared with the standard growth performance of Cobb 500. Due to poor hygienic conditions on the farm, conditions for the proliferation of pathogenic microorganisms in the environment and feed were favourable.

Moreover, some predisposing factors such as high altitude and insufficient ventilation were present,

exacerbating the ascites syndrome in this broiler flock. Due to its antimicrobial effect, Biotronic® SE improved the environmental hygiene and prevented the feed from microbial and fungal deterioration.

In addition, dietary supplementation with acidifiers is known to decrease the occurrence of pathogenic bacteria in the gastrointestinal tract thus improving the animals' health status. This was confirmed by the reduction of mortality rates in the Biotronic® SE group compared with the Negative control and Positive control (AGP) groups. In this trial, the addition of Biotronic® SE to the feed was effective in alleviating the effect of ascites caused by microbial factors in broilers.

The Biotronic® product line consists of products available in both powder and liquid forms for application in feed and water - ideal and practical solutions for prevention and control of ascites outbreaks in broiler flocks.

Conclusion

- In modern animal production acidifiers have been proven to be an efficient alternative to antibiotics.
- Dietary acidification contributes to environmental hygiene, with a continued function through either the feed or water into the animals' gastrointestinal tract.
- Biotronic® SE has been successful in alleviating the effects of various intestinal diseases, with its action against ascites in broilers the latest application available to producers.

PRESS RELEASE

Vetphage Pharmaceuticals
a Proteon Pharmaceuticals Company

Time to Address the Rise of Antibiotic - Resistant E. Coli in Poultry

Marek Rymanowski, Head of Veterinary Services – Proteon Pharmaceutical's Poland and
Dr Krishna Chandra Sahoo, Global Product Manager, Proteon Pharmaceutical's India

Marek Rymanowski

Dr Krishna Chandra Sahoo

E. coli is part of the gut microflora in chickens, and not all of them are harmful. However, pathogenic *E. coli* can overwhelm the immune system of birds, causing septicemia and death. *E. coli* infection in poultry farms can cause significant economic losses. The weight loss results in drop in the rate of egg production, mortality and other secondary infectionscan deal a serious blow to the production system. Farmers have to shell out extra for cleaning, disposal and treatment with antibiotics, which is becoming increasingly ineffective due to the emergence of multidrug resistant strains.

Farm practices

Poor husbandry practices exacerbate the spread of colibacillosis. Poultry house environments have high numbers of *E. coli* due to fecal contamination. The most common infection route is the inhalation of fecal matter contaminated dust, which contains *E. coli* in large numbers. If birds do not have access to water and clean feed, and if the litter remains wet due to bad ventilation, the bacterial transmission will take place at a rapid pace via respiratory mucus and fecal contamination.

Farm practices also have a hand to play in the high levels of antimicrobial resistance in poultry farms. Birds reared in deep litter system are more exposed to fecal contamination and hence at a greater risk. Antibiotic resistant strains of *E. coli* are twice as prevalent in broiler farms when compared with layer, as they are mostly reared in deep litter system. They also have a higher prevalence of multidrug resistance and Enterobacteriaceae that produce extended spectrum beta-lactamases, which are enzymes that break down antibiotics and make them ineffective. All of these factors point to a much more indiscriminate use of antibiotics in broiler farms, which need to sustain a rapid growth of chickens over very short periods.

At present, there is no regulation in antibiotic use in animal food production. Most small-time poultry producers use antibiotics for growth promotion rather than treatment. Antibiotics are considered more effective than sanitation or hygiene measures because untrained farm workers are not likely to follow strict biosafety measures. This should not come as a surprise as the odds of resistance is higher in independent farms. Contracted farms, which are largely owned by big players have to adhere to strict production protocols set down by the producer. Consequently, they employ better veterinary care and hygiene methods, and use

Nalidixic acid	86 percent
Tetracycline	47 percent
Ampicillin	43 percent
Cotrimoxazole	42 percent
Ciprofloxacin	39 percent

Figure 1: Levels of antibiotic resistance

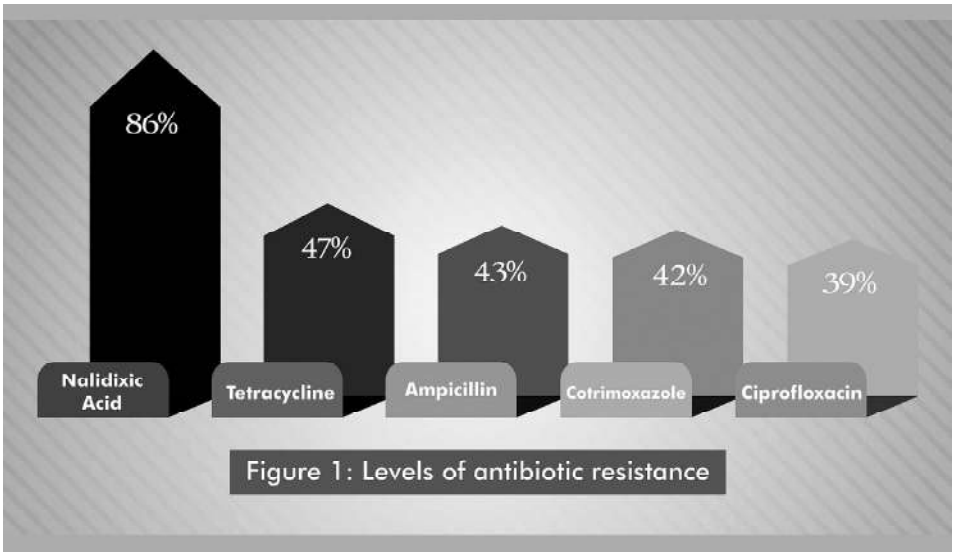


Figure 1: Levels of antibiotic resistance

antibiotics more judiciously. Independent farms do not have a support system and have need for rapid growth for profitability in a competitive poultry market. Hence, they tend to misuse antimicrobials.

Human transmission and risks

Antibiotic resistant strains of the bacteria can also pass on to humans who consume contaminated poultry meat. *E. coli* infections that are linked to the consumption of meat products often cause intestinal illness. Such outbreaks are carefully monitored by public health bodies and tend to receive a lot of negative media attention, which has an adverse impact on poultry sales.

The pandemic has also brought to attention the zoonotic potential of pathogens and there are enough studies that document the transmission of antibiotic resistant *E. coli* from poultry to humans. Some strains of *E. coli* have been in circulation in poultry flocks for years, and there could have been countless occasions for the strain to spillover to humans. But the possibility is potentially more dangerous now, given the increasing levels of antibiotic resistance. At a time when poultry farmers are already recovering from the production and sales losses caused due to the unfounded coronavirus scare, they cannot afford the luxury of sweeping a real problem such as this under the rug.

How do we address it?

With increasingly disposable incomes and an increase in the demand for poultry products, anti microbial use in food production is only likely to go up. Ideally, the government should ban the non-therapeutic use of antibiotics in livestock farming. However, even if the center bans the use of antibiotics, there is no guarantee that it will gain traction at the local level. Farmers, on their part, should follow proper feed hygiene, water hygiene and biosecurity measures to curtail the spread of pathogenic bacteria in their flock. As for the problem of multidrug resistance, they will soon be able to switch over to effective, commercially available alternatives.

Bacteriophages are particularly effective in targeting specific bacterial cells. For the uninitiated, bacteriophages are beneficial viruses that replicate within the host to target and destroy specific bacterial species. Since phages don't infect eukaryotic cells, they are safe for use in the treatment of bacterial infections in animals& poultry. Studies have demonstrated that bacteriophage treatment was comparable to treatment with enrofloxacin. When used together, it improved the effectiveness of colibacillosis treatments. Earlier this year, a study published in Nature identified two phages that can effectively infect almost all strains of Shiga toxin producing *E. coli*, which can pass from animals to humans and cause severe stomach cramps, bloody diarrhea and thrombocytopenia. Both the commercially available therapeutic applications and research point to one thing – custom bacteriophages are going to be the future in the control and treatment of bacterial infections.

PRESS RELEASE

Vetphage Pharmaceuticals
a Proteon Pharmaceuticals Company

Prevention and Treatmentof *Salmonella* and *E. Coli* in Poultry

Dr Krishna Chandra Sahoo, Global Product Manager, Proteon Pharmaceuticals India

Dr Krishna Chandra Sahoo

The United States Department of Agriculture (USDA) recently reported that global chicken meat production is expected to increase by 2 percent in 2021 to 102.9 million tonnes. With the rising demand for chicken meat and eggs, the poultry industry faces a tough challenge – how to control bacterial diseases among the flocks. The most common infections associated with poultry are *Salmonella* and *E. Coli*. In the United States, the prevalence of *Salmonellosis* infection among chicken flocks is around 75-90% whereas, for *E. Coli*, it is around 90-95% (https://europepmc.org/article/med/28915819). The annual economic losses in the country resulting from *Salmonella* infections is more than $11.58 billion. While there is no consolidated study to accurately estimate the prevalence of *Salmonella* and *E. Coli* infections in poultry stock in India, sporadic studies have found significant presence. A study conducted in a Tamil Nadu city in 2017 found prevalence of 33% *Salmonella* in raw chicken meat. Another study conducted in two northern Indian towns in 2012 found *Salmonella* in about 5% eggs and *E. Coli* strains in about 28% of eggs examined.

Amid the rising concerns of rampant *Salmonella* and *E. Coli* infections and emergence of their antibiotic resistant strains, the poultry industry is searching for viable alternatives to combat these bacterial infections to keep animals and humans safe& to mitigate the AMR risk to improve food safety.

The Threat of *Salmonella* and *E. Coli* to Poultry

Salmonellosis is a major cause of infection in poultry that stems from bacteria belonging to the *Salmonella* genus. There are different types of species and each result in a specific disease. For example, Arizonosis occurring among chicks is a septicemic disease caused by *Salmonella enterica*; Pullorum Disease (PD) also known by the name Bacillary White Diarrhoea which causes a high mortality rate in young chickens (2-3 weeks), results from infection with *S. Pullorum*. Some other examples include, Fowl Typhoid (FT) which again is an acute septicemic disease caused by *S. Gallinarum* and affects adults and growing chickens. Paratyphoid (PT) infection is a common occurrence among chickens usually caused by *S. Enteritidis* and *S. Typhimurium*.

On the other hand, there are different strains of *Escherichia Coli* or *E. Coli* present in the digestive tracts of chickens. Even though most of these strains are harmless, there are certain strains that can be grouped into the APEC or Avian Pathogenic *E. Coli* which can be a major cause of infections among chicken. The APEC strains causes colibacillosis which is a major cause of mortality and morbidity in poultry.

It's hard to overlook the economic impact of these infections. These infections can result in huge economic losses to poultry farms. On top of that, they can be a big hindrance to international trade as there is increased risk of transmitting infections to humans.

The Growing Concern of Antibiotic Resistance

For the prevention and treatment of *Salmonella* and *E. Coli*, poultry farmers commonly use antibiotics on a routine basis. However, the excessive and

indiscriminate use of antibiotics has led to the development of antibiotic resistance (AR) strains in pathogens This has not only led to treatment failures but economic losses and transmission of antibiotic resistant strains to humans.

Usually, antibiotics eliminate susceptible bacterial strains and leave behind those strains that can resist the drug. The resistant strains further multiply and transfer their resistant genes to other bacteria. These resistant bacteria can then be transferred from poultry to humans through consumption of poultry products or handling.

A study conducted to determine the antibiotic susceptibility of 156 pathogenic *E. Coli* strains showed that every strain was resistant to at least 2 antibiotics and more than 66% of the strains were resistant to at least 7 antibiotics. (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5553156/)

Another major disadvantage of antibiotics is that they kill the good bacteria inside the gut as well that are important for healthy development of poultry which can prevent other fungal, viral and bacterial infections.

Bacteriophages can address the Problem

Countries like Sweden, the United Kingdom, the Netherlands, Denmark and other European nations have already banned the use of growth promoting antibiotics in animals. Indian government has recently banned the use of last resort antibiotic colistin in food animals to check the growing menace of drug resistant superbugs.

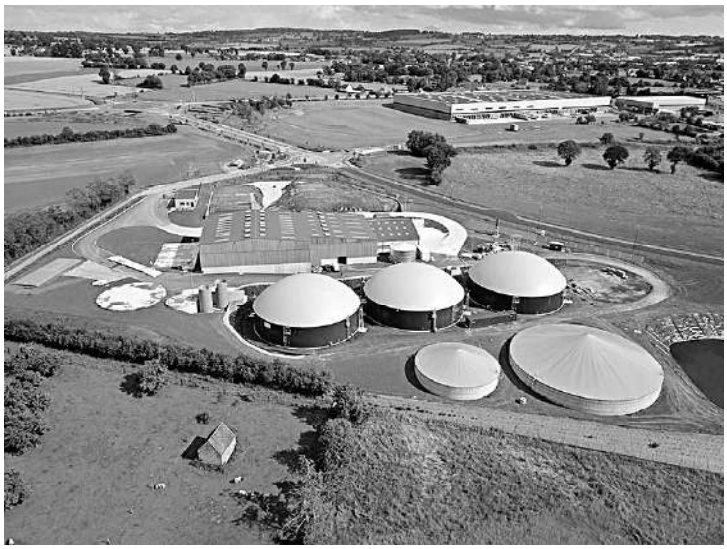
As an alternative to cut down on the usage of antibiotics, bacterio phages or simply 'phages' have turned out to be a safe bet for poultry farmers. Bacterio phages happen to be viruses that attach to the infectious bacteria, replicate inside it to create more no. of new phages, due to increase in population of new phages inside the bacteria, there is outburst of bacterial cell wall to release the new phages into the environment, this process is called amplification, that allows phages to effectively destroy the targeted bacteria. The best part is that apart fromdestroying the targeted bacteria, it doesn't have any negative impact on other cells of animals or humans.

Phage therapy is emerging as a growing trend to combat antibiotic-resistant infections. At Proteon Pharmaceuticals, we are working to revolutionise the approach to eliminate pathogenic bacteria through controlled and sustainable ways without causing any harm to the birds and humans. Our phage-based poultry feed additives BAFASAL+G and BAFACOL helps to control pathogenic *Salmonella* and Avian Pathogenic *E. Coli* respectively across poultry species and breeds. Phage therapy helps reduce mortality rate, improves production performance, feed conversion ratio and reduces the unnecessary usage of antibiotics. It is the need of the hour to popularize and promote the growth of such sustainable solutions to ensure optimal health of poultry flocks and reduce the risk of infections in humans. Poultry farmers also need to be educated about the ill-considered use of antibiotics along with better control practises and proper disease management to tackle the rising prevalence of bacterial diseases in poultry.

PRESS RELEASE

French Biomethane Plant of WELTEC BIOPOWER Goes Live

11-Million-Euro Project Welcomed by Population

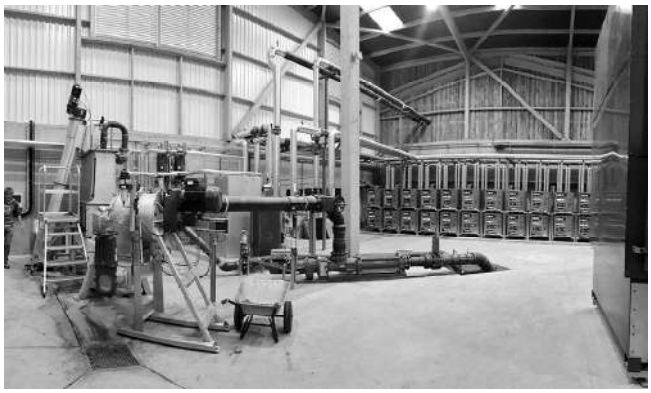


The WELTEC biomethane plant in Vire, France, has been running at full load since November 2020 and, with the generation of green energy, ensures CO2eq savings of 5,300 tons per year.

2020French Biomethane Plant of WELTEC BIOPOWER Goes Live11-Million-Euro Project Welcomed by PopulationIn November 2020, a biomethane plant of the German energy plant manufacturer WELTEC BIOPOWER went live in Papillonnière near the town of Vire in Normandie, France. The operator of the 11-million-euro project, which was rolled out by WELTEC and its project partner Agripower France, is Agrigaz Vire, a local company that comprises 40 operations along the agricultural value chain. The plant has created three permanent jobs and digests a yearly amount of about 70,000 t of substrates to biogas, which is then processed to biomethane.

The raw material mix that comes from a radius of approximately seven km largely consists of inexpensive waste and other by-products from agriculture and the food industry. The regional, sustainable nature of the biomethane project is underlined by the fact that the operations belong to the agricultural company and the substrates come from the region. Two thirds of the 200 t of input substances needed every day consist of animal waste such as cattle and pig manure and liquid slurry. Whey, sludge and abattoir waste from food operations and from a pet food manufacturer belonging to Agrigaz account for another 20 percent. The rest of the substances is made up of maize, grass, whole plant silage, straw and grass silage.

The use of biomethane plays a key role in reducing greenhouse gases: Every hour, 270 standard m³ of the green biomethane are fed into the public gas grid for use as an energy source or as alternative fuel throughout France. „With this amount, some 5,300 t of CO2e can be saved every year“, explains Alain Priser, who is in charge of WELTEC BIOPOWER‘s business in France. „Used as a natural gas equivalent, the biomethane could cover



The technical equipment has been put together individually for the AD plant. Heat pumps (rear) ensure efficient use of waste heat and the MULTIMix (front left) shreds the substrates in advance.

as much as 20 percent of the gas demand of Vire (population: 18,500). In the mobility sector, this quantity would be sufficient for driving a climate-neutral distance of 35 million km by car or circling the equator 890 times every year“ says Alain Priser.

The solid input substances are introduced to the system with the help of two moving floor feeders (140 m³ and 98 m³) and a vertical screw feeder (30 m³). Additionally, some of these substrates are shredded in two MULTIMix units and mixed to ensure optimum digestion. The liquid substrates are first buffered in seven upstream tanks. Following the hygienisation of some input substances, the substrates are transported to three 4,436-m³ stainless-steel digesters. Two storage units are used solely for the purpose of storing the digestate for use as high-quality fertiliser by the agricultural company‘s farmers. „Our farmers thus also benefit from this by-product in that they save chemical fertiliser. Ultimately, this too is a key to reducing greenhouse gases“, underlines Yves Lebaudy, the Managing Director of Agrigaz Vire.

A rather exceptional heat concept is used in Vire: The biomethane plant is supplied with the exhaust heat from a pet food manufacturer located at a distance of only 500 m, whose production process delivers enough heat for the hygienisation procedure of the biogas plant. For this purpose, Agrigaz Vire has connected the two locations with a hot water pipe. Through the use of heat pumps, part of the energy from the exhaust heat can be recovered and used to produce heat at a higher temperature level. Thanks to this thermodynamic system consisting of 24 heat pumps with a capacity of 50 kW each, all substrates except for the regrowing raw materials can be treated for one hour at 70°C in three hygienisation tanks of 15 m³ each. By contrast, the digesters do not need to be heated very much, as the hygienised input substances already have the temperature level required for the digestion process.

The sustainable cycle has resulted in a high level of acceptance by the entire population: „We are proud of our innovative joint project, which enjoys the backing of our farmers, politicians, entrepreneurs and residents alike“, says Yves Lebaudy. Especially the inhabitants of Vire are eager to participate. They can deposit their waste in a new recycling centre with waste handover docks. In this way, they are able to actively support the operation of the biomethane plant with their own raw material, thereby contributing to the success of the project as a whole.

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- Broiler 3.5% Concentrates
- Broiler 2.5% Concentrates
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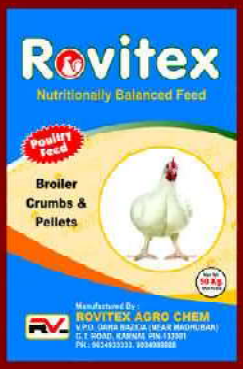
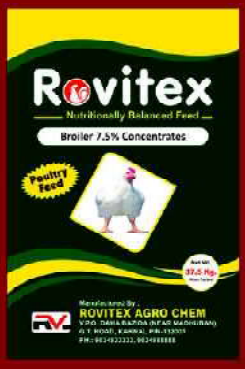
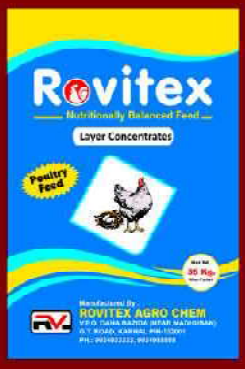
Layer Concentrates:
- Layer 5% Concentrates
- Layer 10% Concentrates
- Layer 25% Concentrates
- Layer 35% Concentrates

Broiler Crumbs/Pellets:
- Broiler Pre-Starter Crumbs
- Broiler Starter Crumbs
- Broiler Finisher Pellets







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Ectoparasites of poultry and control strategies

Sakshi Sharma, Devina Sharma, Virender Pathak and SK Khurana
DGCN College of Veterinary & Animal Sciences,
CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur

Poultry products are considered as one of the most important sources of food for humans worldwide. Indigenous poultry production is gaining popularity among villagers and some urbanites due to simple maintenance conditions, adaption of poultry to different climatic conditions and acceptable product yield. Like all other animals, poultry too suffer from a wide range of diseases, ectoparasitic infestation being one of them. Ectoparasites of poultry live on the skin or penetrate into the skin or even into the air sacs and some live under the feathers.Heavily infested flocks can suffer substantial economic losses as a result of reduction in egg production,reduced weight gain, anemia,lower hatchability,increased feed costs and increased mortality.

CommonEctoparasites of Poultry

Lice Avian lice,which belong to the order Mallophaga normally feed on bits of skin or feather products. In intensive poultry systems, the most common and economically important louse are-*Menopon gallinae*(shaft louse) feeds mainly on skin and feather debris but may also suck blood from the wounds it produces. It prefers the chest, the shoulders and the back of birds. Eggs are whitish and are laid in clusters at the base of the feathers.*Menacanthus stramineus*(body louse) is the most common species on domestic birds .It feeds mainly on feather debris. It lives mostly on the skin of birds and prefer body parts with few feathers e.g. around the vent,but in case of heavy infestations it may be found also on the head,under the wings and on the chest. The eggs are laid in clusters on the feathers or directly on the skin. *Lipeurus caponis*(wing louse)is found mainly in the inner part of wing,tail and head feathers. *Goniodes gigas*(giant chicken louse) feed on feathers and underlying skin over most parts of their host's main body.It cause pruritus, restlessness,debility and reduced productivity.

Mites The mites that attack poultry have life cycles with four stages: egg,larva,two nymphal instars and adult. The nymphs and adults have piercing-sucking mouth parts and take blood meals from birds. Several mite species can be found on poultryand most important are -*Dermanyssus gallinae*(red mite) is a blood sucking mite. It affects mainly laying hens and can be a serious problem in traditional and backyard poultry. It stays hidden in cracks and crevices in the poultry house during the day and comes out to feed on the birds at night. This mite can transmit several diseases such as avian spirochaetosis,fowl typhoid,etc. *Ornithonyssus sylvarium*(northern fowl mite) -is an obligate blood sucking parasite. Unlike red fowl mites that visit their hosts only for feeding this mite spend their whole life on the host where it feeds on blood and is a source of irritation to the bird. Eggs are laid in masses at the base of the feathers,usually in the vent area. *Ornithonyssus bursa(*tropical fowl mite)-has similarities with the northern fowl mite.One particular feature of this mite is that they can cumulate in the nests of wild birds in and around human dwellings. *Cnemidocoptes gallinae*(cause depluming itch in poultry). It does not suck blood but burrows into the skin along the shafts of the feathers, which easily break.Affected birds bite themselves vigorously and may pull out their own feathers. It can also cause cannibalism among the birds. *Cnemidocoptes mutans*(cause scaly leg in poultry) and burrow into the epithelium resulting in hyperkeratosis which is described as crusty appearance of the legs and feet.

TicksTicks are obligate ectoparasites that feed on the blood of their hosts. The fowl tick(*Argas persicus*)belong to the soft- bodied ticks of family Argasidae.It is found worldwide in tropical and subtropical countries and is the vector of *Borrelia anserina*(Avian spirochetosis) and the rickettsia *Aegyptianella pullorum* which causes fowl disease(Aegyptianellosis). These are particularly active in poultry houses during warm and dry weather. Infection with fowl ticks may cause poor appetite,weight loss, anaemia, toxemia and paralysis. Egg production decreases. Red spots can be seen on the skin where the ticks have fed.

Fleas*Echidnophaga gallinacea*(sticktight flea) is unique among poultry fleas in that the adults become sessile parasites and usually remain attached to the skin of thehead for days or weeks.Adult fleas are small reddish-brown to black, wingless blood sucking insects.

Prevention and Control of ectoparasites in poultry

The drugs and chemicals used against ectoparasites known as ectoparasiticides. Most ectoparasiticides act as neurotoxins at central nervous system synapses,axons or neuromuscular junctions leading to spastic or flaccid paralysis. Various modes of application are available for administration of ectoparasiticide such as dips, sprays, dusting powders and tags. Different classes of ectoparasiticides most commonly used are Organochlorines: (Lindane, Methoxychlor- dust, spray, pour on,,Organophosphates (Dimethoate, fenthion Malathion, coumaphos, Dichlorvos as dip, spray), Carbamates **(**Carbaryl,Propoxur as dip, dust, spray), Formamidines**(**Amitraz as dip, spray), Pyrethroids(Cypermethrin, Permethrin, Deltamethrin as dip, spray), macrocyclic lactones (ivermectin, etc. The frequency of ectoparasiticidal will depend upon the intensity of the infection and seasonal dynamics related to the parasite. The efficacy of specific compounds can vary against target species, and resistance to insecticides may develop in specific locations, especially with incorrect use, such as sub-dosing, or with prolonged and repeated product use. Therefore, product labels should be carefully read. Once poultry have been infested, control may be achieved by spraying or dusting the birds and litter with different ectoparasiticides Spray treatments must be applied with force to penetrate the feathers in the vent area. Thorough application of the insecticide to the base of the feathers of all birds is required. A follow up application will be necessary to kill newly hatched larvae. Permethrin strips that can be hung in the pens are also available for lice and mite control. In addition to treating the birds, the inside of the house and all hiding places such as nest boxes, sideand end walls,cages, cracks, crevices and other stationary equipment must be treated thoroughly using a high pressure sprayer. Dimethoateand fenthion (Organophosphate compounds) may be used as residual house sprays when poultry are not present. Systemic control with ivermectin or moxidectin is effective for short periods, and require repeated use.

However, insecticides should be considered the last resort after sanitation and management methods have been tried. Sole reliance on insecticides often results in insecticide resistance. Therefore, the important aid in controlling ectoparasites other than insecticides are sanitation and biological control.Good sanitation practices are important to prevent buildup of ectoparasite populations. Sanitation involves-removal and disposal of dead birds and broken eggsimmediately, cleaning up and disposal of feed spills, proper drainage in the poultry yards,etc.Entomologists encourage the use of biological control methods in poultry houses.For example, Use of fly parasitoids, which are nothing but tiny wasps, and are the naturally occurring enemies of manure-breeding flies. They kill flies in the pupal stage. These fly parasitoids are specific

to flies anddo not bite or stingpeople or birds and usually go unnoticed by those living near poultry operations. They self- propagate in the process of controlling pest flies.

Thus, ectoparasites are constraints to the economic cattle and poultry production. These can cause economic losses and disease.However, with good management and sanitation, their numbers could be kept at a reasonably low counts.

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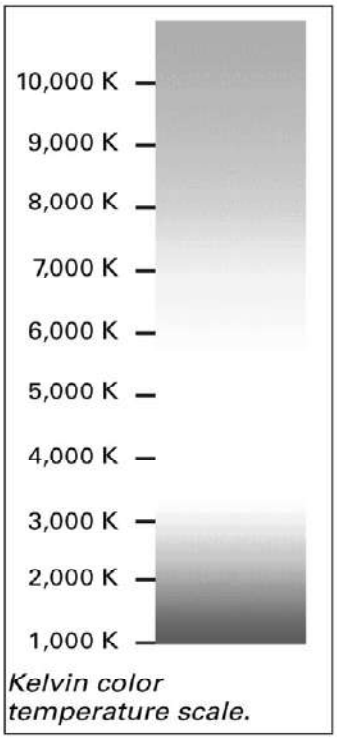
IMPACT OF TARP COLOR ON POULTRY LIGHTING

INTRODUCTION

Around the world, many chicken farms are open sided without solid walls. These houses usually have curtains or tarps to help block the sunlight, control the temperature, adapt behavior, improve ventilation, or a combination of reasons. Many different color curtains have been observed in use; however there is not always scientific reasoning for the color of curtain utilized. In recent years, the impact of light color, spectrum, and bulb style have been shown to impact growing pullets and laying production.

In general, research has proven that cool lights (4000–6000K) with a more blue-green color spectra help increase pullet growth, while warm lights (< 3000K) with more red-orange color spectra help increase egg production. All of the research was done with different color and different style light bulbs. Curtains act as a filter for sunlight coming into the house, and this filtered light may have an impact on pullet or layer performance.

The impact of curtain color depends on both the type of bulb used inside the house (if one is used) and the amount that the light filtering through is used for lighting the birds. The goal of this technical bulletin is to better understand the impact curtain color has on sunlight, and discuss how this might influence the flock's growing and laying performance.



Kelvin color temperature scale.

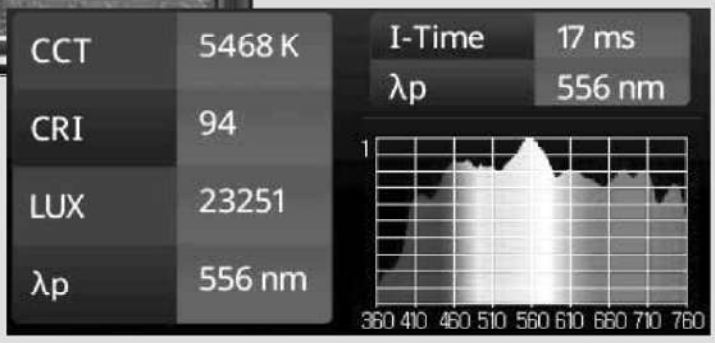
> 4000K: cool, dominant blue spectrum

3500K: neutral and balanced with red, green and blue spectra

< 3000K: warm, dominant red spectrum

SUNLIGHT

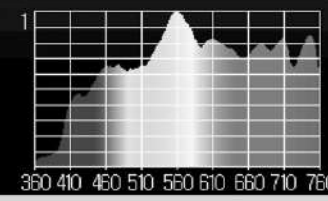
- Bright day with a few light clouds
- May 31, 2016
- The window glass and angle of the sunlight dimmed the light from > 100,000 lux down to around 23,000 lux



Technical Update – IMPACT OF TARP COLOR

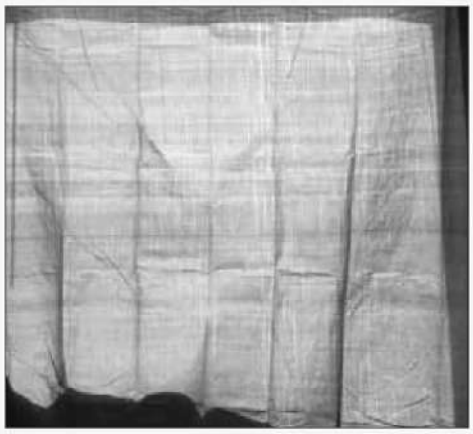
SUNLIGHT WITH BLINDS

CCT	4585 K
CRI	88
LUX	335
λp	559 nm
I-Time	1000 ms
λp	559 nm

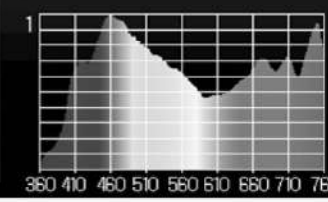


- Closing the blinds most of the way removes some of the blue spectrum
- Overall the spectrum looks very similar to sunlight
- The light intensity is 2 log lower

SILVER/BLUE

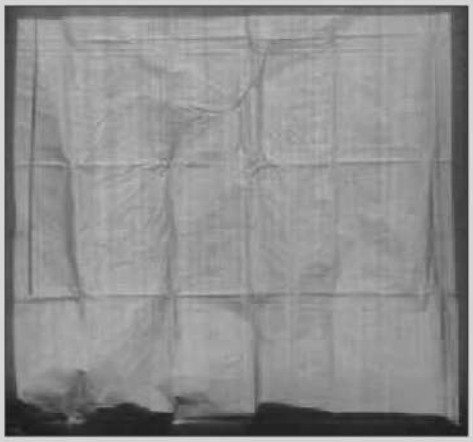


CCT	9009 K
CRI	93
LUX	374
λp	462 nm
I-Time	760 ms
λp	462 nm

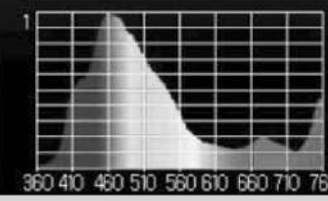


- The silver blue tarp has two peaks of light with both blue and red coming through
- Allows a full spectrum of light through while providing good dimming from the full sun
- Good tarp for layer houses or pullet houses

BLUE

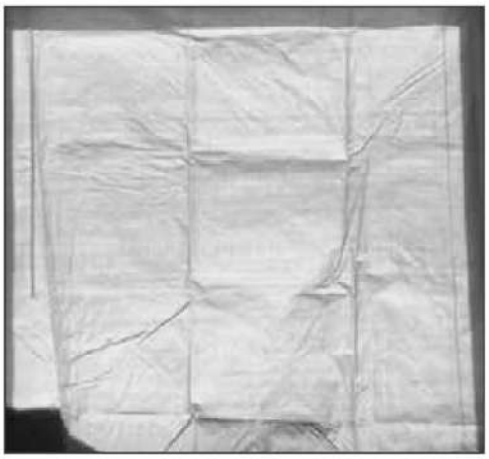


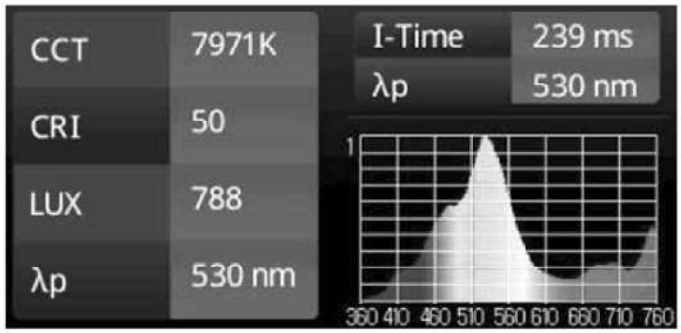
CCT	0 K
CRI	0
LUX	699
λp	462 nm
I-Time	239 ms
λp	462 nm



- Removes almost all of the red spectrum
- May be good for calming birds but red spectrum is vital for keeping good egg production
- Not recommended as sole light source for a layer house
- Would be excellent for use in a pullet house

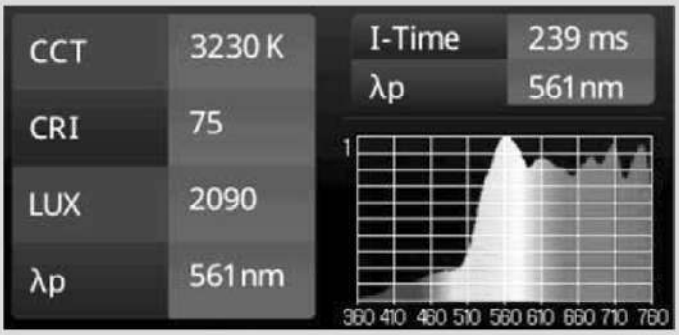
GREEN





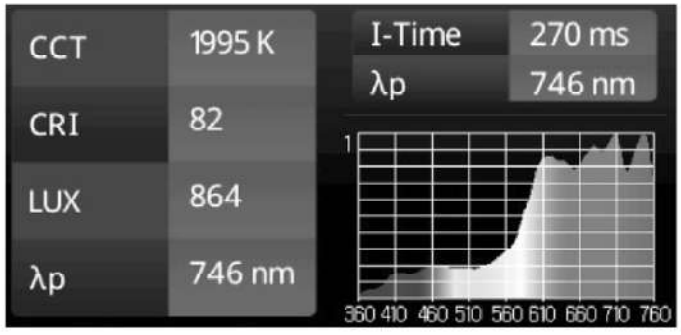
- Allows some blue spectrum and very little red spectrum
- Some yellow and orange spectrum comes through (not ideal for the sole light source of a layer house)
- Excellent for use in a pullet house

YELLOW



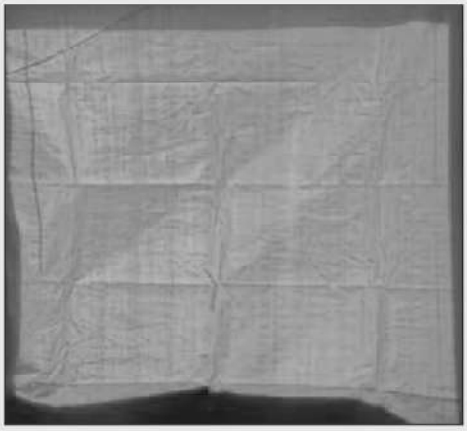
- Allows full spectrum of yellow, orange, and red light through while blocking blue and part of green
- Yellow curtains were least effective at dimming the light; measured light intensity was more than twice that of any other tarp
- Would not provide enough light blocking to be used in a layer house even though the spectrum is ideal

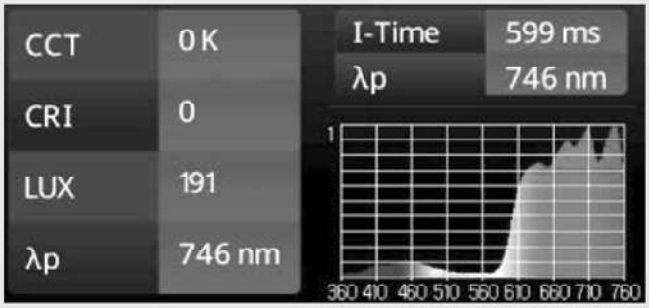
ORANGE



- Allowed the second-most light through, but was still more than half of the yellow tarp
- The yellow tarp started allowing light to pass the curtain around 560 nm, while the orange tarp starts around 610
- Would be a good layer curtain if more light was blocked

RED





- Red curtains provide the most dimming of incoming light
- The first peak of light is around 636 nm, which is ideal for stimulating laying hens
- The combination of light blocking and red spectrum makes this a very good tarp choice for laying hens

SUMMARY

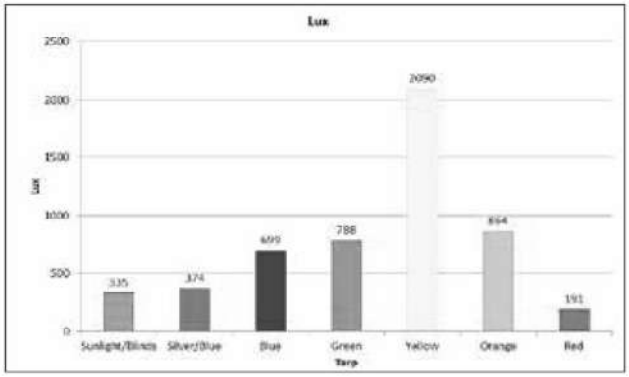
The curtain color exerted a significant effect on the intensity and color spectra of incoming sunlight. This study illustrates that curtain color should be an important consideration in house design.

Tarp colors providing a color spectra that would benefit pullets: blue, green, silver-blue.

Tarp colors providing a color spectra that would benefit layers: orange, red, silver-blue.

We did not test white or black tarps because of the variation in materials used in production of those tarps. It would be expected that a white tarp will not block any spectra, but will create various levels of shade. A black tarp would be expected to completely block any sunlight from coming through the curtain.

Overall, it is important to understand the light dimming ability of the curtains you are using. Due to tarps differing in thickness, test a tarp with a regular light meter to see how much light is being blocked. Additionally anticipate a logarithmic scale difference in light intensity if curtains are raised and lowered throughout the day/week/month/year.



Light intensity with different colored tarps.

Finally, understand the difference in light intensity between light coming through the tarp and light from the light bulbs. If the light coming in from the tarp is far greater than what is from the light bulbs, this may have an impact on production. Furthermore, LED lights can be selected to provide a more compatible spectrum with tarp light than compact fluorescent lights (see the "Understanding Poultry Lighting" technical bulletin at www.hyline.com).

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BROILER LIFTING RATES FOR THE MONTH OF NOVEMBER 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	109	109	109	100	95	95	89	89	89	91	91	94	94	94	94	94	95	95	89	85	87	90	90	92	92	92	93	95	105	105
Karimnagar	109	109	109	100	95	95	89	89	89	91	91	94	94	94	94	94	95	95	89	85	87	90	90	92	92	92	93	95	105	105
Warangal	109	109	109	100	95	95	89	89	89	91	91	94	94	94	94	94	95	95	89	85	87	90	90	92	92	92	93	95	105	105
Mahaboobnagar	109	109	109	100	95	95	89	89	89	91	91	94	94	94	94	94	95	95	89	87	89	93	93	93	93	93	94	95	105	105
Kurnool	109	109	109	100	95	95	89	89	89	91	91	94	94	94	94	94	95	95	89	87	89	93	93	93	93	93	94	95	105	105
Vizag	103	103	103	98	93	93	87	87	87	87	87	87	87	87	87	87	87	87	87	80	82	85	85	87	87	87	87	89	98	98
Godavari	110	110	110	105	100	100	94	94	94	96	96	98	98	98	98	98	98	98	92	87	89	92	92	94	94	94	94	96	105	105
Vijayawada	113	113	113	108	103	103	97	97	97	99	99	101	101	101	101	101	101	101	95	91	93	96	96	98	98	98	98	100	110	110
Guntur	113	113	113	108	103	103	97	97	97	99	99	101	101	101	101	101	101	101	95	91	93	96	96	98	98	98	98	100	110	110
Ongole	113	113	113	108	103	103	97	97	97	99	99	101	101	101	101	101	101	101	95	91	93	96	96	98	98	98	98	100	110	110

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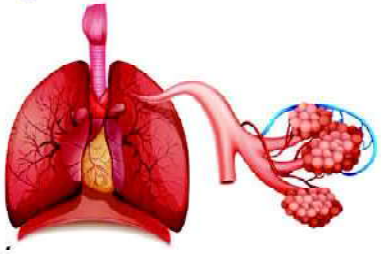

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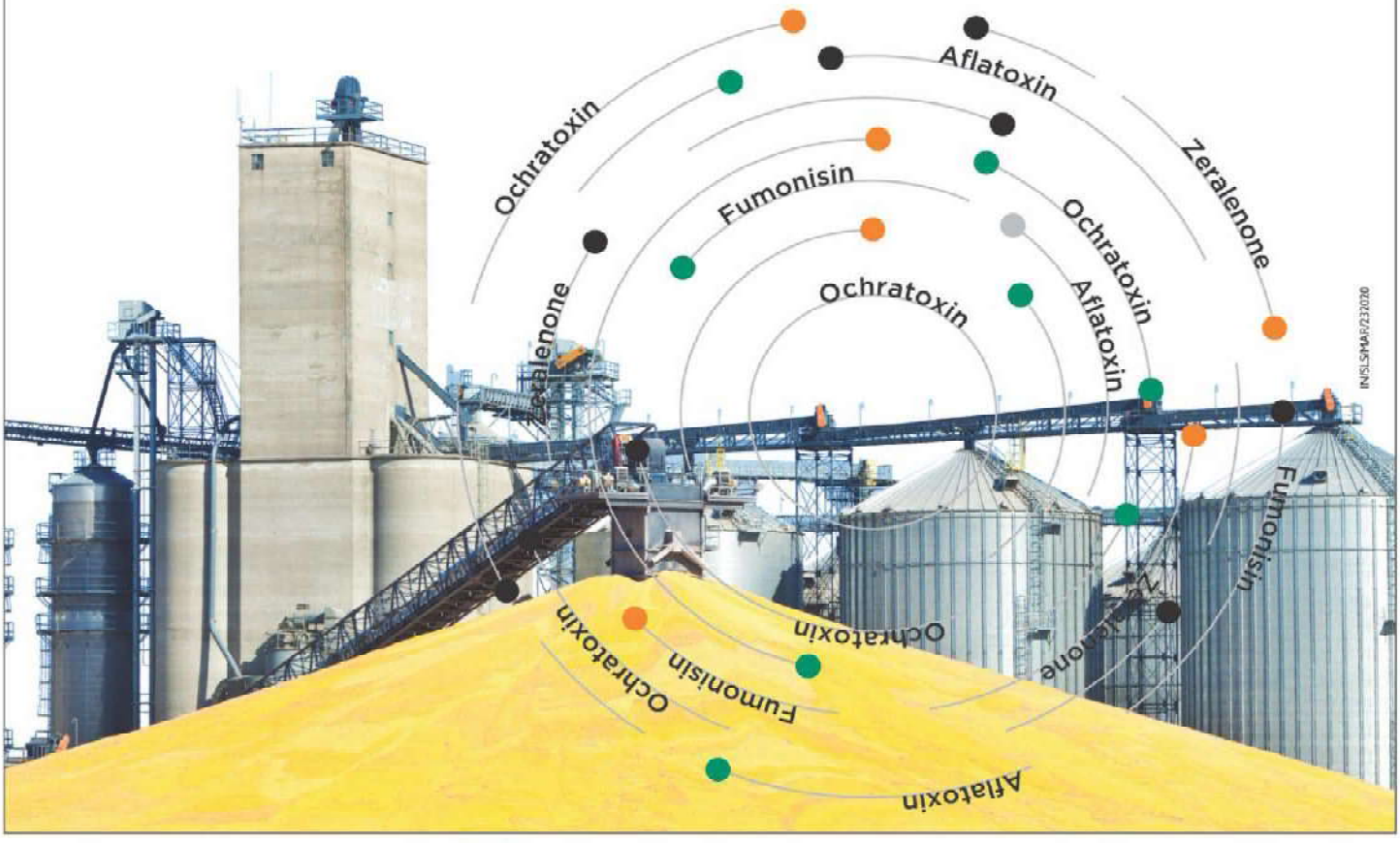

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