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by JONES-HAMILTON CO.

The Science of Litter Management®

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Poor Air Quality at Brooding Impacts Respiratory Disease and Bird Performance

Even though most poultry producers have specific brooding management programs, many flocks are affected by respiratory problems that can be directly attributed to a failure to follow those guidelines. The results of improper brooding management take the greatest toll later in a flock's life, but early management is often overlooked as the source of later respiratory disease and performance declines.

Three Major Management Factors Contribute to Respiratory Diseases

Respiratory disease in poultry is a much discussed topic. New respiratory virus serotypes occur occasionally and can cause some respiratory disease in specific regions. However, all too often we tend to blame vaccines that may or may not have been applied correctly, say chicks or poults were of poor quality, or blame a host of other factors when really the problem is caused by a failure to follow basic management guidelines.

While there are many factors that will affect respiratory disease incidence and severity, the vast majority of losses are caused by three major management factors that when followed conscientiously will keep respiratory problems to a minimum:

- proper air and litter temperature control
- ammonia levels
- vaccine application

If these three critical factors are not properly managed, even the best quality chicks or poults will have respiratory problems, will not be a profitable flock and will not be successfully protected by the vaccine program.

Only strict adherence to basic proper management techniques will help prevent respiratory diseases and result in birds reaching their maximum genetic potential. Getting a flock off to a good start is vital and brooding management is extremely important in respiratory disease prevention and flock profitability.

1 Proper Temperature Control

With today's broiler and turkey genetics the birds are able to turn feed into meat faster and more efficiently than ever before. This fast-paced, highly demanding feed efficiency is very stressful to birds. To reach their maximum genetic potential and prevent respiratory disease, these birds must be grown in a stress-free environment. Modern high-efficiency birds are acutely sensitive to small temperature fluctuations. If birds are chilled, we quickly see them huddling together to conserve body temperature. Instead of using energy to develop meat, they are using energy inefficiently to maintain body temperature. The result is an unevenly sized flock, birds with greater susceptibility to respiratory diseases and an ultimate loss of revenue.

Poultry house temperature control is still one of the most commonly misunderstood and mismanaged aspects of a successful respiratory disease control program. Proper temperature control means avoiding temperature fluctuations and avoiding brooding birds at temperatures outside their thermoneutral zone. Air temperature is the most commonly monitored area, but it is litter temperature that is most critical. Young birds will lose body temperature if the litter is even one or two degrees too cool.

Litter temperature must be monitored prior to flock placement in the house. If litter temperature is low and air temperature is adequate, then the flock will still suffer from being out of their thermoneutral zone. Houses must be properly preheated prior to bird placement and this cannot be done properly immediately prior to placement. Two days prior to bird placement the air temperature must be brought up so the litter has sufficient time to warm up uniformly both across the house and deep into the litter.

Also, as litter is heated it releases deep moisture and ammonia. The litter should be preheated long enough to allow this process to be completed before bird placement so that the moisture and ammonia are not venting when the flock is in the house. In most farms it takes a minimum of 48 hours for the litter to cure properly. This purge of ammonia from the pre-heating process should be completed prior to bird placement.

Proper temperature control also involves monitoring of constant temperature from day to evening to keep the flock consistently in its thermoneutral zone. Besides chilling of a flock, temperature fluctuations throughout the entire day are a primary cause for greater susceptibility of a flock to respiratory disease.

Numerous scientific research articles have been published linking improper temperature control with respiratory disease and other disease conditions including ascites that are observed later in the flock's life. Remember that improper temperature control is a severe stress to birds and will result in a weakened immune system, higher incidence of respiratory disease, more severe respiratory conditions, harder vaccination reactions and rolling vaccination reactions.

2 Ammonia Levels

Ammonia is an often under estimated stress to birds and both a direct and indirect influence on bird health, performance and profitability. The quality of the air in your chicken or turkey house is directly related to your birds' ability to respond to respiratory disease challenges. Ammonia causes the first breach of your birds' respiratory defenses that will then allow viral and bacterial invaders entrance into your birds' respiratory system.

The first line of defense that birds have against respiratory challenges is the mucociliary elevator of the trachea. As a bird inhales, bacteria, viruses, and other particles become trapped in the mucus that covers the cilia in the bird's trachea. The cilia are small fibers that beat upward, in effect forming an elevator that lifts the trapped particles in the mucus out of the trachea where they can be either coughed out or swallowed by the bird. Proper functioning of this defense mechanism depends on the integrity of this tracheal lining. Any insult to the mucociliary elevator will impair the bird's ability to clear particles and disease organisms from the respiratory tract.

The most common cause of damage to the mucociliary elevator is ammonia. With levels as low as 20 ppm (barely detectable by the human nose), ciliostasis or paralysis of the cilia can be seen. This results in bacteria and viruses being trapped by the mucus and the paralyzed cilia are unable to remove them from the bird. The trapped particles can then fall deeper into the bird's respiratory tract causing disease. Higher levels can cause deciliation or a loss of cilia which allows immediate access to viruses (including vaccine viruses) and bacteria into the bird's respiratory system and bloodstream. Small particles (dust, bacteria and viruses) cannot be cleared adequately from the respiratory system and are able to make their way into the air sacs where airsacculitis will most likely develop.

Chickens and turkeys are most susceptible to ammonia insults during brooding and when boosting respiratory vaccines in the field. Excessive moisture within a house or improper decaking and litter tilling will encourage ammonia production. Proper litter management and ventilation to maintain ammonia levels below 20 ppm should be followed at all times to ensure that your birds are able to maintain their natural defense mechanisms in order to fight off respiratory disease challenges.

In one study by Terzich et al. looked at the effect of PLT® litter acidifier on the impact of development of respiratory disease lesions in broilers. Birds were raised either on untreated litter or litter that was treated with PLT® and then vaccinated with their normal respiratory disease vaccine program. The ammonia levels ranged from 53-115 PPM in the untreated houses. In the houses treated with the litter acidifier, ammonia levels were reduced to 5 ppm at placement and never rose to more than 20 PPM throughout the four week study (table 1). Because of this reduction in ammonia, body weights and gross airsac lesions were greatly reduced in the birds raised on the PLT®-treated litter. (table 2)

These improvements in respiratory health were also noted at the microscopic level (table 3). The application of live respiratory virus vaccines must cause a mild inflammatory response in the birds in order to be effective. The cilia of the bird must be functioning well at the time of vaccine application in order for the damage from the vaccine to be kept at a healthy minimum. The cilia that make up the mucociliary elevator were more intact and had milder inflammation in the birds raised in the lower ammonia environment compared to the other birds in the study.

Table 1. Mean atmospheric ammonia levels (ppm) in pens where litter was or was not treated with PLT®[a]

Day after Treatment[b]	Ammonia levels following litter treatment	
	None	PLT®
-1	96[c]	88
0	95	5*[d]
7	72	14*
14	115	20*
22	115	22*
48	53	19*

[a] *Poultry Litter Treatment®.*
[b] *Treatment was immediately prior to chick placement at 1-day-old.*
[c] *Mean ammonia levels are parts per million. In the present study, ammonia levels in excess of 25 ppm were considered to be excessive.*
[d] *Asterisk indicates a significant (P<0.001) difference between treatments.*

Table 2. Mean body weights, thoracic air sac gross lesion scores and lung: body-weight retios in broiler chickens that were raised on litter treated or not treated with PLT®[a]

Day of age	Measured parameter	Treatment	Effect on parameter	P value[e]
23 days	BW[b]	None	712	
		PLT®	767	< 0.0001
	ASLS[c]	None	1.36	
		PLT®	0.12	< 0.0001
	LBWR[d]	None	0.65	
		PLT®	0.69	< 0.001
49 days	BW	None	2204	
		PLT®	2312	< 0.01
	ASLS	None	1.36	
		PLT®	0.36	< 0.0001
	LBWR	None	0.71	
		PLT®	0.75	< 0.05

[a] *Poultry Litter Treatment®.*
[b] *Mean body weight (g).*
[c] *Mean gross air sac lesion score; scores were 0 = clear, 1 = cloudy, 2 = cloudy with minimal caseous exudate accumulation and 3 = severe caseous exudate accumulation.*
[d] *Mean lung: body weight ratio (g).*
[e] *T-test; significance level is shown.*

Table 3. Histopathological findings in the mucosa of tracheas of 23-day-old broiler chickens raised in pens that were treated or not treated with PLT®.

Lesion	Litter treatment	Histopathology score[b]	Numbers of chickens with these injury magnitudes[c]				P value[d]
			Minimal	Mild	Moderate	Marked	
Less of cilia	None	4.00*	0	0	0	20	< 0.001
	PLT®	3.25	0	1	13	6	
Hypertrophy and hyperplasia	None	6.00*	0	0	0	20	< 0.001
Inflammation	None	6.00*	0	0	20	0	< 0.001
	PLT®	5.20	0	16	4	0	
Necrosis	None	4.60*	0	8	12	0	< 0.001
	PLT®	3.65	10	8	2	0	

[a] *Poultry Litter Treatment®.*

[b] *See text for scoring method. Numbers are mean scores. A t-test was used to analyse these data, and asterisk indicates a significant (P < 0.0001) difference between treatments.*

[c] *Twenty chickens in each group.*

[d] *A chi-square test was used.*

3 Vaccine Application

A third management factor affecting respiratory disease is vaccine application—not the vaccine program, rather just the application or implementation of the vaccination program. The specific vaccines that are used in a given geographical area are dependent on many factors that are not related to onfarm management. Assuming that the vaccine program is correct for the specific challenges in your area, application of those vaccines in the poultry house is equally important as vaccine choice.

Often, changes are made in the vaccine program when application is really the problem. Application problems may include poor handling of the live virus vaccines prior to application. The vaccine virus will die if the vaccine is kept too warm or not administered quickly. If the vaccine is administered through the water, then water lines must be fully charged with vaccine following bird water deprivation so that when the birds have access to water they drink a full dose of vaccine. If the water lines are not fully charged, then the birds will drink plain water and not vaccine, and therefore not be protected against that specific virus.

Vaccines are not magical. They work with the bird's immune system to protect that bird from later exposure to the same virus with which they were vaccinated. If the vaccine is not applied or handled properly, then the birds will not be protected and respiratory disease will occur. Vaccination teams dedicated solely to administering vaccine are the most effective means of vaccination, and proper spray vaccination is more effective than water vaccination in protecting birds from respiratory diseases. Respiratory disease may start in the flock from wild virus strains or vaccine virus strains if vaccine is improperly applied.

An important thing to remember about vaccines is that they are powerful tools for controlling respiratory disease only if properly used, so consulting with the various vaccine manufacturers for demonstrations of proper vaccination techniques is recommended.

Many factors lead to respiratory disease. However, if these three basic management practices (proper temperature control, ammonia control and vaccine application) are adhered to, then many respiratory disease problems and the subsequent loss in revenue can be avoided.

Reference

*Terzich, M., Quarles, C., Goodwin, M. A. and Brown, J. (1998) 'Effect of Poultry Litter Treatment®
(PLT®) on the development of respiratory tract lesions in broilers', Avian Pathology, 27: 6, 566 — 569*

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