

# AMMONIA – the Invisible Killer

Dr B C Dutta

- Ammonia (NH<sub>3</sub>) is a gas present in the atmosphere of every poultry house.
- Ammonia is an invisible, water-soluble, colour less alkaline gas with a very distinct pungent odour. Anhydrous NH<sub>3</sub> gas is lighter than air and will rise & does not settle in low-lying areas. However, in the presence of moisture (in high relative humidity poultry house), the liquefied NH<sub>3</sub> gas forms vapours that are heavier than air and settle at bird's level in poultry house.
- Poor ventilation, loose droppings and faulty, poor drinker management are common causes of wet litter and ammonia accumulation in poultry houses.



Pic 1: Packed Poultry House



Pic 2: Loose Dropping

- People can smell ammonia at concentrations above 20 ppm.

TARGET	< 10 ppm
Human detection	> 5 ppm
Damage of Respiratory tract Cilia	20 ppm (3 min)
Body weight/FCR affected	25-51 ppm
Eye damage /Stop Feeding /Dehydration	46-102 ppm (12 hours)

- Ammonia emissions in poultry houses are mainly due to high protein formulated chicken diets who have no storage for amino acids consumed beyond the requirement for protein synthesis, so the excess amino acids are deaminated and the derived nitrogen is excreted in the urine mainly as uric acid (80%), ammonia (10%) and urea (5%), (Goldstein and Skadhauge, 2000). However, the large amount of uric acid excreted is readily converted to ammonia through a chain of reactions catalysed by enzymes, which are present in the manure.
- Ammonia gas in poultry houses seriously affects the health of the birds.
- Good litter management and ventilation will minimise the level of ammonia, improve productivity, reduce the likelihood of respiratory diseases, improve the birds' welfare and provide a pleasant, safe environment for workers.

Several factors affecting the atmospheric ammonia concentration in the poultry houses:

- a) Type of bedding (Litter) material used

- b) Bird's activity
- c) The frequency of manure removal in layer & breeder
- d) Humidity; high humidity in monsoon favours NH<sub>3</sub> accumulation in poultry houses.
- e) Ventilation or Wind movement across the shed; poor wind movement due to any reason fails to clear the ammonia produced in the poultry houses.



**Pic 3: Poor Ventilated Chicks house**



**Pic 4: Packed Brooding House**

- f) Housing density of chicks; high stocking density means more ammonia production in the given area.
- g) The pH of Drinking water; alkaline pH favours unwanted microbial growth in the intestine leading to watery faeces resulting excess ammonia in poultry house.
- h) Litter Temperature; ammonia production is more in hot litter temperature.
- i) Intestinal Health of birds; poor intestinal health due to mycotoxins, dysbacteriosis, Necrotic Enteritis & Coccidiosis leads to damage of Intestinal mucosa resulting loose drooping, indigestion, feed passage ending with high litter ammonia in poultry house.

### **Harmful effects of ammonia on birds**

1. Ammonia is irritating and toxic to a chicken's respiratory system. Damage to the mucous membranes of the respiratory system increases the susceptibility of birds to bacterial respiratory infection, especially *E. coli* infection
2. Ammonia toxicity refers to an inflammatory eye condition in chickens, caused by exposure to prolonged or high amounts of ammonia.
3. Ammonia concentrations above 25 ppm is toxic to chickens.
4. The main clinical symptom is the inflammation of the cornea and conjunctiva of the eye (conjunctivitis).
5. Young, growing chicks are more susceptible to ammonia damage than adult chickens.

6. Chickens are more prone to developing ammonia toxicity during the winter season, due to increased time spent indoors, with reduced ventilation and accumulated manure.
7. High levels of ammonia have a negative impact on overall livability, weight gain, feed conversion, condemnation rate at processing and the immune system of the birds.
8. High NH<sub>3</sub> level in the poultry house suppressed the immune response of broiler chickens. There is an interactive effect between NH<sub>3</sub> and RH on the immune response of broilers.
9. High levels of ammonia in a poultry house have negative impact on poultry growth particularly at an early age. It has been (Moore et al. 2008) found that NH<sub>3</sub> levels as low as 20 ppm compromise the immune system of chickens, making them more susceptible to diseases & damage to respiratory system.

### **Damage to the respiratory system**

The effect of NH<sub>3</sub> on the mucosal surface of trachea ranges from paralysis of cilia, to loss of cilia, to injury of the mucosal epithelium of affected birds. The type & degree of damage depends on the concentration of NH<sub>3</sub> in the air & the length of exposure. Cilia are tiny, hair-like projections on the surface of the trachea to form the mucociliary blanket, which is responsible for entrapping & cleaning particles inhaled from the environment. Poultry house dust is a reservoir for *E. coli* as attached to the surface. Normally inhaled particles are entrapped in mucus secreted by mucous glands, propulsive actions of cilia continuously move the mucus with entrapped particles up the trachea toward the pharynx, thus preventing the particles from reaching the lungs & air sacs. When cilia become paralyzed or are lost due to high NH<sub>3</sub> in the poultry house, mucus on the mucosal surface of the trachea cannot be cleared, and thus entrapped bacteria on dust particles may reach the lungs & air sacs and cause infections like airsacculitis, pneumonia & septicemia caused by *E. coli* in poultry.

### **Damage to the eyes**

Atmospheric NH<sub>3</sub> at high concentrations causes conjunctivitis and damages the cornea of the eyes. Swelling and reddening of the eyelids, reddening of the conjunctive and partial or complete closure of the eyes are common clinical signs.

### **Control of Ammonia Problem in poultry House:**

- Avoid unnecessary high protein level in feed, rather more scientific approach of feed formulations with digestible amino acid profile helps controlling ammonia.
- Maintaining optimum Intestinal health through effective control on Necrotic Enteritis, subclinical coccidiosis & mycotoxicosis prevents excess ammonia production. This can be done through efficient feed formulation.
- Litter Management:
  - a) Selection of Litter Material – Rice Husk or Saw dust
  - b) Litter Thickness – Rice husk 2 inches in summer & 3 inches in monsoon & winter. For Saw dust 1.5 inches in summer & 2 inches in monsoon & winter.
  - c) Humidity & Temperature of Litter – Maintaining the poultry house temperature & RH in bird's comfort zone through heating in winter and use of Fans in monsoon & summer helps controlling ammonia problem in poultry houses.
  - d) Drying of mud floor before chicks housing



**Pic 5: Raking of Litter**

- e) Physical Raking of litter daily is very important to maintain good litter condition and to minimise ammonia in broiler house
- Ventilation is the single most important issue to control ammonia related all problems in poultry shed. Proper ventilation or wind movement across the shed is very important throughout the life of a chick to live without harmful effect of ammonia.



**Pic 6: Well Ventilated Poultry Farm**

Improper curtain management during both monsoon & winter due to fear of splash water entry into the shed in monsoon or chilly wind entry into the shed.



**Pic 7: Packed Curtain during Rain**

In winter curtain covering shall be done after considering the age of the birds, temperature of the specific time & wind movement.



**Pic 8: Winter Early Morning Ventilation in Chicks House**



**Pic 9: Curtain Hanging keeping Min Ventilation**

Poor litter & abnormal respiratory sounds are very common during monsoon due to mismanagement of curtain which may be managed by using side pandals.



**Pic 10: Side Pandal**

- Ammonia binder containing plant extract, probiotic & acidifier may be added to feed to control ammonia in poultry houses especially during monsoon & winter.