

# DISEASE PREVENTION IN POULTRY FARMING THROUGH WATER HYGIENE

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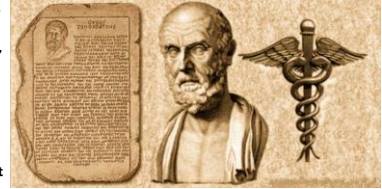
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## DISEASE PREVENTION IN POULTRY THROUGH WATER HYGIENE

**Disease** is a disorder of structure or function in a human, animal, or plant, especially one that produces specific symptoms or that affects a specific location and is not simply a direct result of physical injury



*"All Diseases begins in the gut"*

**Disease**, a disordered or incorrectly functioning organ, part, structure, or system of the body resulting from the effect of genetic or developmental errors, infection, poisons, nutritional deficiency or imbalance, toxicity, or unfavorable environmental factors.

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## DISEASE PREVENTION IN POULTRY THROUGH WATER HYGIENE



*"Water is life's matter and matrix, mother and medium. There is no life without water."*

*Albert Szent-Gyorgyi*



Broiler Chick Drinks 10 Litres Water in 5 Weeks



Layer Chick Drinks 160 Litres Water in 80 Weeks

**Safe Drinking Water is Essential for Normal Health & Production**

Gut Epithelial Surface is much higher than external body Surface

Huge volume of Water passing through Gut Epithelial Everyday

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## DISEASE PREVENTION IN POULTRY THROUGH WATER HYGIENE

➤ Water, the 'forgotten' nutrient; safe water intake is as important as feeding birds a healthy feed

➤ 70% of Chicken Body Wt is Water



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➤ Water consumed in greater quantity (5 x Maize) than any of the other nutrient

➤ Birds may die rapidly from lack of water than lack of any of the other nutrients.

### FUNCTIONS OF WATER IN THE BODY

- As major component of blood Water helps transporting Nutrients & O<sub>2</sub> to the cells and carrying waste away
- Water is directly related with all physiological activities; Digestion, Respiration, Excretion, Production, Movement, etc
- Water is a primary element in two most important processes of body; Digestion & Respiration, which is key to Thermoregulation
- For optimal Growth & Production, birds need free & convenient access to safe water

WATER CONTENT (%) OF CHICKEN MEAT		
PRODUCT NAME	RAW	COOKED
Whole Chicken	66%	60%
White Meat Chicken with Skin	69%	61%
Dark Meat Chicken with Skin	66%	59%



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### WATER & FEED CONSUMPTION RATIO

Ambient Temperature °C/°F	Feed vs Water Intake in Broiler
4°C / 39°F	1 : 1.7
20°C / 68°F	1 : 2.0
26°C / 79°F	1 : 2.5
30°C / 86°F	1 : 3.0
37°C / 99°F	1 : 4.5



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### EFFECT OF DRINKING WATER DEPRIVATION

- Performance: Water deprivation results reduced Feed Intake, Low Body Weight & Egg Production and Poor Feed Efficiency
- Dehydration: Water deprivation causes Dehydration & Immuno-suppression
- Thermo-regulation: Deprivation causes Failure to maintain Body Temperature with enlarged heart followed by multi organ failure & death
- Chemical Imbalance: All body processes from joints to brain function get disturbed with water dehydration when blood gets concentrated
- Digestive Problem: Water deprivation effects Intestinal Villi Height & Crypt Depth - impairs digestion resulting Poor Growth & Production



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### DRINKING WATER QUALITY REQUIREMENT

Very High growth & Feed efficiency in Broiler and High Hen-house & Hen-day Production in Layer

Today's chicken became less tolerant to stress; with a significant stress from Poor Drinking Water Quality

Water Samples			
Contaminants, Minerals & Ions			
	Average Level	Maximum Acceptable Level	
Total Bacteria	0 CFU/ml	100 CFU/ml	Iron (Fe)
Coliform Bacteria	0 CFU/ml	100 CFU/ml	Lead (Pb)
PH	6.5 - 7.5	6.5 - 8.5	Magnesium (Mg)
Total Hardness	50 - 150 ppm	150 ppm	Nitrate
Calcium (Ca)	50 mg/l	n/A*	Sulfate
Chloride (Cl)	10 mg/l	200 mg/l	Zinc (Zn)
Copper (Cu)	1.000 mg/l	0.5 mg/l	Sodium (Na)

\*N/A - Not Applicable

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What might have had no impact on birds 15 years ago, could be devastating for the bird of today

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**DRINKING WATER QUALITY PARAMETERS**

- **Physical** : Clear & Odourless
- **Contamination**: Free from unwanted Chemical & Microbes
- **Hardness/ TDS**: 110
- **pH** : 6.0 – 6.8
- **Taste** : Pleasant



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**DRINKING WATER PARAMETER – PHYSICAL APPEARANCE**

Drinking Water must be Clear without any Turbidity, Colourless & Odourless



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**DRINKING WATER – CHEMICAL CONTAMINATION**

- Water must be Free from any unwanted Chemical Contamination
- Poultry performance affected by even 10 ppm Nitrates from sewage or fertilizer contamination of water

Improve Infrastructure & Husbandry practice to provide Safe drinking water to avoid Chemical Contamination



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**DRINKING WATER – MICROBIAL CONTAMINATION**

- Water shall be Free from any Microbial Contamination for optimum health & performance
- Poultry producers are critical about the quality of the feed, but the quality of drinking water often not receive the attention it deserves although volume is 3 times
- In poultry house environment, there is always chance of contamination of water from litter, dust & discharges of birds
- Water SANITIZER need to be used to protect the birds from unwanted contamination throughout the production cycle



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### DRINKING WATER – MICROBIAL CONTAMINATION

Water **SANITIZER** use is a compulsion in poultry

- To prevent Water borne diseases
- To control horizontal spread of Bacterial & Viral infections
- To get optimum digestive capacity from Intestine



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1. Iodine Salt –
  - i) Effective against Bacteria, Virus & Fungi
  - ii) Effective in hard water
  - iii) Very quick action
2. **Didecyl dimethyl ammonium Chloride (DDAC)** – broad spectrum bactericidal & fungicidal
3. **Chlorination** – Most common & most economic

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### WATER HARDNESS & DRINKING WATER QUALITY

**Water Hardness** is the amount of ions which have lost two electrons (divalent cations) dissolved in the tested water and is therefore, related to

**Total Dissolved Solids (TDS)**, a measure of all inorganic & Organic Solids dissolved in the water

Water Hardness Scale		
mg/L & ppm as CaCO <sub>3</sub>	dH	Classification
0 - 75	0 - 4	Soft
75 -150	4 - 8.5	Slightly Hard
150 - 300	8.5 - 17	Hard
300+	17+	Very Hard

- Hard water is water that has a high mineral content
- The main difference between TDS and Hardness is that TDS include inorganic substances that cannot be filtered through a filter paper
- Whereas Hardness is due to the presence of Magnesium and Calcium as carbonate, sulfate & chloride

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### WATER HARDNESS & DRINKING WATER QUALITY

- Hardness reduces efficacy of Sanitizer/disinfectant
- Interferes with administration of many Medicines & Vaccines
- Hard water can clog pipes & Nipples, Scale build up around nozzles/outlets
- **Hardness & TDS of water are directly proportional to each other**
- **The higher the TDS the more will be the Hardness of water**



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### DRINKING WATER HARDNESS – THINGS TO DO

The most common way of removing drinking water hardness is to install a water softener, which replaces the Ca<sup>2+</sup> and Mg<sup>2+</sup> with Na ions by Ion Exchange Resin or by Reverse Osmosis



Conventional water-softening for household use depend on an ion-exchange resin where hardness is reduced by replacing "hardness ions" Mg<sup>2+</sup> and Ca<sup>2+</sup> with Na<sup>+</sup> or K<sup>+</sup>

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### DRINKING WATER HARDNESS – THINGS TO DO

Reverse Osmosis (RO) uses an applied pressure gradient across a semipermeable membrane to overcome osmotic pressure and remove water molecules from the solution with Hardness ions.

The membrane has pores large enough to admit water molecules to pass; but  $Ca^{2+}$  &  $Mg^{2+}$  will not fit through the pores.

The resulting soft water supply is free of hardness ions.



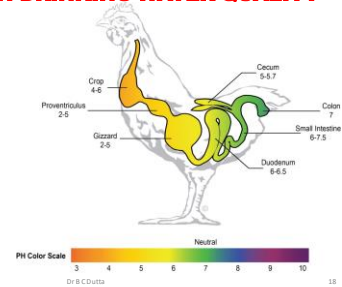
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### ROLE OF pH IN DRINKING WATER QUALITY

- pH is a measure of acidity/alkalinity
- pH value < 7 is considered Acidic, while those > 7 are Alkaline
- Hardness & pH are not always directly associated, but generally, hard water has a higher pH
- pH heavily impacts water quality & efficacy of disinfectants



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### ROLE OF pH IN DRINKING WATER QUALITY

Table - 1: pH Standards for poultry drinking water

pH Level	Consideration	Indication
≤ 5	Poor	Performance issues, metal corrosion of equipment and water lines
6.0 to 6.8	Satisfactory	Recommended for poultry
> 8	Unsatisfactory	Impacts on water sanitizers and results in "bitter" taste
5 to 8	Tolerable	Maximum acceptable levels

Low pH helps Newly hatched chicks to adapt to dry feed because low pH promotes beneficial microbial growth & aids enzyme production



Liquid Water ACIDIFIER help maintaining Water pH at desired level

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- Gut Microbiome and digestive enzyme activity are sensitive to pH
- Coliforms, including *E. coli* and *Salmonella*, grow best at alkaline pH
- In contrast, beneficial bacteria like *Lactobacilli* thrive at more acidic pH
- Water pH @ 4.5–5.5 promotes the growth of beneficial bacteria in the gut and discourages the growth of coliforms

### DRINKING WATER QUALITY ISSUES (Non-Infectious)

7 Signs in Poultry that Indicate Poor Water Quality without producing specific Disease

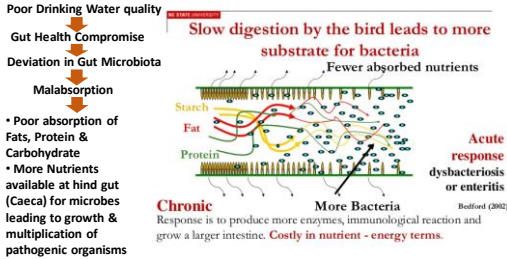
- Lower Oxygen uptake in the blood, resulting in lethargic birds, reduced fertility in breeders & bluish comb, lobes & head ; due to high nitrate (>1mg/litre) level
- Respiratory Problems; attributed by high Nitrate (>200mg/Litre) level
- Diarrhoea attributed by high Potassium (>300mg/Litre) level
- Cerebral symptoms, torticollis & lameness; results of high Na (>200mg/Litre)
- Blocked nerve conduction, smell of rotten eggs; attributed by high Sulfide level, converted to sulfate under the influence of bacteria (>250mg/Litre)
- Intestinal Dysfunction, due to high level of Iron (>5mg/Litre)
- Weaker Immune Response & Loose Drop; attributed by Mycotoxins produced by moulds

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**POOR WATER QUALITY EFFECT ON GUT HEALTH**

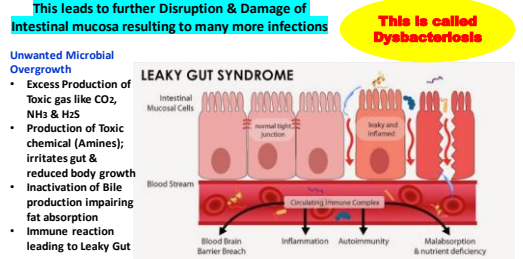


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**POOR WATER QUALITY LEADS TO GUT HEALTH COMPROMISE**



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**POOR WATER QUALITY LEADS TO GUT HEALTH COMPROMISE**

- Poor Drinking Water quality with high pH & high TDS (Calcium) may leads to Enteritis, diarrhoea & Pasty Vent condition
- If the condition continues, then mal-absorption of protein leads to undigested protein in hind gut resulting Necrotic Enteritis. Maggot development is a common outcome of persistent NE in broiler



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**WATER pH & DRINKING WATER VACCINATION**

Drinking Water is the most easy & common Route of Vaccination in Poultry

Drinking Water Quality (pH & TDS) is very poor in most part of this subcontinent

High TDS & Alkaline pH often minimizes Vaccine Efficacy

**Role of water chemistry and stabilizers on the Vero-cells-based infectivity of Newcastle disease virus live vaccine - October 2017 *The Journal of Applied Poultry Research* 27(1)**

- Minimum reduction in virus infectivity was recorded in the water with neutral or slightly alkaline pH, while the virus was relatively less stable at extreme pH conditions
- Maximum reduction of infectivity was observed in the water with pH 9.00 in which the virus was completely inactivated within 3 hours
- Minimum reduction in infectivity was observed in the water with neutral pH, followed by the ones with a pH of 8.00, 6.00, 5.00, and 9.00
- In all water samples, T-90 values (time required for 90% reduction in virus infectivity) were highest (485 minutes) at neutral pH (pH 7.00) and lowest (102 to 134 min) at an extreme alkaline condition (pH 9.00)
- Results indicate that water with a pH range of 7.00 to 8.00 is suitable for administration of NDV live vaccines

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## WATER pH & CHLORINE SANITIZATION OF WATER

[www.poultrysite.com](http://www.poultrysite.com) – 25 September 2019 by Aviagen

- Chlorination is an effective way to achieve water sanitation, as it provides residual protection against recontamination, is easy to use and cost effective
- Chlorination requires an acid application to adjust water pH to 5-7. The effectiveness of chlorination depends on the water pH, which should be between 5–7.
- An acidifier may need to be added to the water to ensure that the pH is within the recommended range
- When chlorine is added to water it forms Hypochlorous acid (HOCl) which is the active sanitizing agent, and OCl<sup>-</sup> which is not an effective sanitizer
- When the water pH exceeds 7, more OCl<sup>-</sup> and less HOCl is formed and so the effectiveness of the chlorination is significantly reduced
- For best flock performance drinking water needs to be acidic rather than alkaline before Chlorine treatment throughout the production cycle

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## WATER ACIDIFIER EFFECT ON GUT HEALTH

- Combination of Organic Acids like Acetic, Formic, Propionic & Butyric acids not only Reduce Drinking water pH to desired level but also helps maintaining Optimum Gut Health
- Field experience shows Combination is better results than any single acid
- Organic Acid reduces Water pH and thus minimizes microbial load in Drinking Water
- Reduce gut pH which is always under threat from ingestion of feed & poor quality water
- Helps maintaining Gut Microbiome by favouring the growth of Helpful microorganisms
- Makes the Gut epithelium unfavourable for the pathogenic bacteria like *E coli* & *Salmonella* for adhesion & colonization
- Increases Villi Height (VH) & crypts depth (CD) and improves digestion & absorption capacity
- Reduce unwanted abdominal Fat content in chicken
- Direct Bactericidal Action: Butyric acid enters the bacterial cell wall through diffusion (Clark and Cronan, 1996) which causes toxicity inside the bacterial cell (Warnecke and Gill, 2005), the reduction in the cytoplasmic pH of the bacterial cell (Choi et al., 2009) leading to the death of bacteria
- Gut Morphology: Butyric acid after ingestion absorbed preferably by enterocytes as a source of energy (Mahdavi and Toki, 2009). It accelerates growth of enterocytes and villus elongation that results in increased villi height and deeper crypts

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## DRINKING WATER BROMO-CHLORO SANITIZATION

Most Common Drinking Water Sanitization is Chlorination; It's 2 types –

- Chlorine Dioxide (ClO<sub>2</sub>) – NADCC (National Disinfection Byproduct Collaborative) release (HOCl) Hypochlorous acid & Hypochlorite acid (OCl<sup>-</sup>) which hydrolyses the Peptide chain of microbes
- Bromo-Chloro molecules (BCDMH, Bromo Chloro Dimethylhydantoin) –
  - Dual action, releasing both Bromine & Chlorine.
  - Bromine is slow releasing & has sustained action
  - Effective at much higher pH
  - Effective in presence of organic matter
  - Bromine is effective against some Viruses, algae & fungi



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## THINGS TO DO TO USE BOREWELL WATER IN POULTRY

- Installation of Water Treatment Unit (RO) to get desired water pH & TDS  
OR  
ACIDIFICATION & SANITIZATION from 1<sup>st</sup> water of 1<sup>st</sup> Day to Lifting/ Culling
  - Use Good Liquid Organic Acids to Reduce water pH to desired level
  - Use Sanitizer after 10 minutes, e.g. Bromo-Chloro Salt, Iodine salt, DDAC or Chlorine Dioxide Tablet.
- CLEANING of Watering System regularly
  - Tank – after every batch with Bleaching Pow
  - Pipeline – Every fortnight with H<sub>2</sub>O<sub>2</sub> preparation
  - Drinker – Everyday for Manual & Bel (Auto) Drinker and Nipple Cups Weekly



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**DRINKING WATER HYGIENE & DISEASE CONTROL**

TAKE HOME MESSAGE

Hygienic Drinking Water

**Control of Water borne Disease**

- Fowl Cholera (*P. multocida*)
- Fowl Typhoid (*S. gallinarum*)
- *E. coli* Infections
- Enteritis

**Optimum Intestinal Integrity**

(Mucous – Microbiome - Tight Junction – GALT)

Reduced Oxidative Stress and optimum Immune System function > Less

Disease Chance & if happens, with reduced severity

Reduced Mycotoxin Effect

Reduced Microbial Invasion through Gut Mucosa (No Leaky Gut); Less Chance of Disease

- Necrotic Enteritis
- Coccidiosis
- Infectious Conyza
- Compylobactor

- Avian Influenza
- IBD or Gumboro
- IBH
- Reovirus Infection
- Rotavirus Infection
- CIA (subclinical)

THANK YOU

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