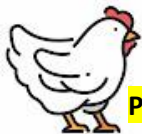


Numida Bio Care Pvt Ltd

Welcome
to
Discussion
on

Water – Precious but Forgotten Nutrient



YouTube

PoultryTroubleshooter_BDutta

www.drbcdutta.com



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Water – Precious but Forgotten Nutrient

Water is Life जल हि जीवन



Water is an
inorganic,
Transparent
Tasteless,
Odorless
& nearly
colorless
Chemical
substance



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

Albert Szent-Gyorgyi

- Liquid under room Temperature
- Water has the important ability to dissolve many other substances; this versatility as a solvent is essential for living organisms

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Why We are Discussing about Water in Poultry???



Broiler Chick Drinks 10 Litres Water in 5 & half Weeks

Gut Epithelial Surface is much higher than external body Surface

High Volume of Water passing through Gut Epithelial Everyday

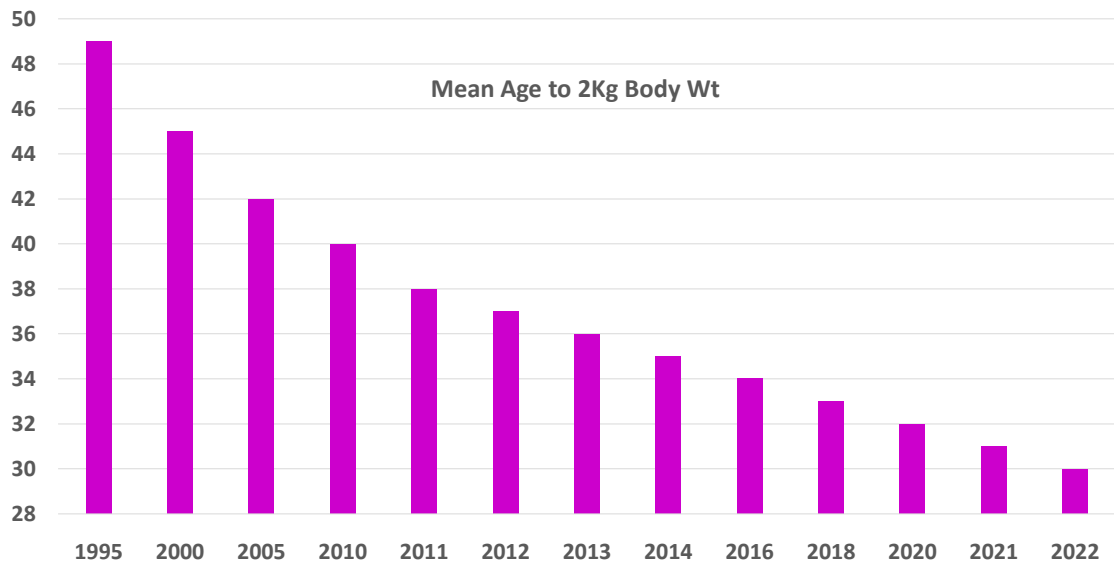
“All Diseases begins in the gut”
- Hippocrates



Layer Chick Drinks 170 - 180 Litres Water in 100 Weeks

Safe Drinking Water is Essential for Normal Health & Production

No of Days to Reach 2Kg Body Weight



Importance of Water in Body

- Safe Drinking water intake is as important as feeding birds a healthy feed
- 70% of Chicken Body Weight is Water



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- Water is the highest consumed (5 x Maize) Nutrient in poultry
- Birds may die rapidly from lack of water than lack of any of the other nutrients.

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Functions of Water in the Body

- As major component of blood Water helps transporting Nutrients & O₂ to the cells and carrying waste away
- Directly related with all physiological activities; Digestion, Respiration, Excretion, Production, Movement & Thermoregulation, etc
- For optimal Growth & Production, Chick needs free & easy 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 in Broiler

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



Water Consumption depends on

- Environment; Temperature & Humidity
- Drinking Water Quality
- Feed Composition & Feed Form
- Gut Health
- Existing Stress Factors like Disease & Litter Ammonia

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Drinking Water Deprivation Effect in Poultry

- Deprivation results Poor Performance - Reduced Feed Intake, Low Body Weight & Egg Production and Poor FCR
- Causes Dehydration & Immuno-suppression
- Causes Failure to maintain Body Temperature (Thermo-regulation) with enlarged heart followed by multi organ failure & death
- Results Chemical Imbalance leading to disturbance in all body processes from joints to brain functions due to thickening of blood (concentrated)
- Affects Intestinal Villi Height & Crypt Depth - reduces digestive capacity resulting Poor Growth & Production



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Common Mistakes >> Water Deprivation

- Less number of Drinker
- Height & Size of Drinker in Chicks
- Water Pipeline – Bending issue, Narrow Angle type fitting
- Clogging of Nipple – Hardness, Medicines
- Size of Farm Water Tank – shall have the capacity of 24 hours water to maintain Water supply in case of Electrical or any mechanical failure



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Drinking Water Quality Requirement

Where are we today?

Broiler:
Very High *growth & Feed efficiency*
AND

Layer:
High *Hen-house & Hen-day Production*



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	50 CFU/ml	Lead (Pb)
PH	6.8 - 7.5	6.0 - 8.0	Magnesium (Mg)
Total Hardness	60 - 180 ppm	110 ppm	Nitrate
Calcium (Ca)	60 mg/l	n/a*	Sulfate
Chloride (Cl)	14 mg/l	250 mg/l	Zinc (Zn)
Copper (Cu)	0.002 mg/l	0.6 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** : Colourless & Odourless
- **Contamination**: Free from unwanted Chemical & Microorganisms
- **Hardness/ TDS**: 110
- **pH** : 6.0 – 6.8
- **Taste** : Pleasant

- In Poultry, Borewell or ground water is the most common source of water
- Largely, Borewell water is the rainwater that seeps deep into the ground and gets trapped between the rock layers



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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 or 5 ppm Iron in ground 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 fraternity is critical about Feed quality, 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



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Water SANITIZER use is a compulsion in poultry throughout the production/life cycle

- To Prevent Water borne diseases
- To Control Horizontal spread of infections
- To get optimum Digestive Capacity from Intestine

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Water Hardness & Drinking Water Quality

- **Hardness** is the amount of dissolved mineral Ca & Mg in the water; Hard water has high level of Ca & Mg ions
- The term hardness originally applied to waters that were hard to wash in, referring to the soap wasting properties of water



- Hardness prevents soap from lathering by developing an insoluble curdy precipitate
- Hard water causes the build-up of hardness scale; dissolved Ca & Mg salts are responsible for scale formation in poultry

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Hardness, TDS & Drinking Water Quality

Total Dissolved Solids (TDS), a measure of all inorganic & Organic Solids dissolved in the water, which can be measured easily

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

- The main difference between TDS and Hardness is that TDS include inorganic substances that cannot be filtered through a filter paper
- Hardness is due to the presence of Mg and Ca 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 & can affect Vaccine Efficacy
- Hard Water can clog pipes & Nipples, Scale build up around nozzles/outlets, drinkers
- Hardness & TDS of water are directly proportional to each other
- **The higher the TDS the more will be the Hardness of water**



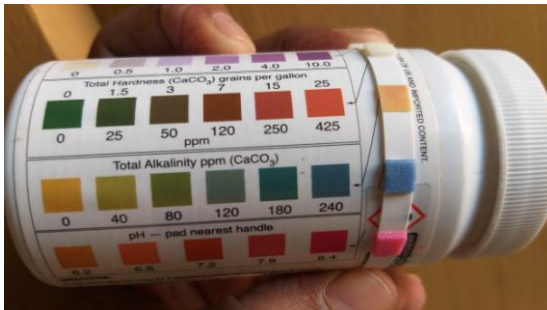
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Drinking Water Hardness – Things To Do

- Most common way of **removing Water Hardness** is to install a Water Softener, which replaces the Ca^{2+} & Mg^{2+} with Na ions by Ion Exchange Resin or by Reverse Osmosis (RO)
- RO uses an applied pressure gradient across a **semi-permeable 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

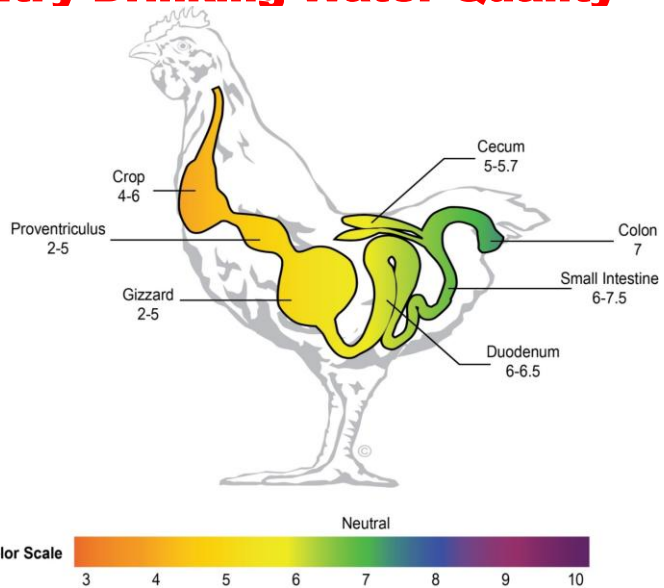
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Role of pH in Poultry Drinking Water Quality

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

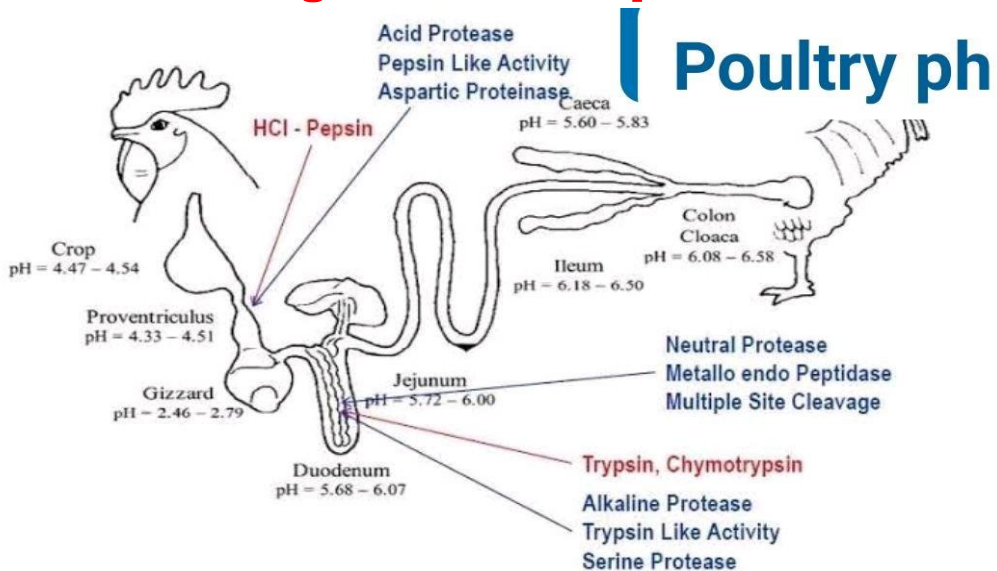


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Chicken Digestive Canal pH is Acidic



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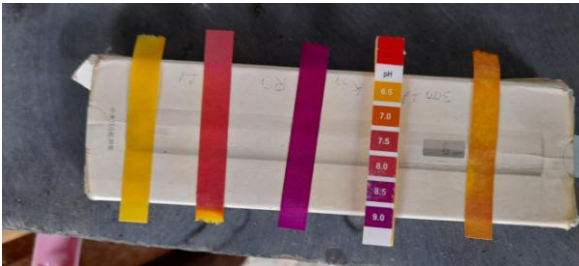
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Role of pH in Drinking Water Quality

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

- 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

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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

Vaccine Efficacy Issue & Vaccination Failure are very common

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 – 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 5.0 - 7.0, the effectiveness of chlorination depends on the water pH, which should be between 5.0 – 7.0
- When chlorine is added to water it forms Hypochlorous acid (HOCl) which is the active sanitizing agent, and Hypochlorite (OCI-) which is not an effective sanitizer
- When the water pH exceeds 7, more OCI- and less HOCl is formed and hence the effectiveness of the chlorination is significantly reduced

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Drinking Water Quality Issues (Non-Infectious)

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

1. High Nitrate (>1mg/litre) level Lowers Oxygen uptake in the blood, resulting in lethargic birds, reduced fertility in breeders and bluish comb, lobes & head
2. Very high Nitrate (>200mg/Litre) level may attribute **Respiratory Problems**
3. High Potassium (>300mg/Litre) level may cause Enteritis & **Diarrhoea**
4. High Na (>200mg/Litre) may results **Cerebral symptoms, torticollis & lameness**
5. High Sulfide (>250mg/Litre) level may block nerve conduction, rotten eggs smell
6. High level of Iron (>5mg/Litre) causes **Intestinal Dysfunction**
7. **Weak Immune Response & Loose Drop**; due to Mycotoxins produced by moulds

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Poor Water Quality Effect on Gut Health

Poor Drinking Water quality

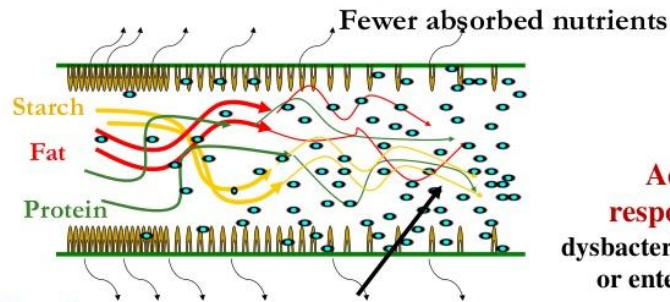
Gut Health Compromise

Deviation in Gut Microbiota

Malabsorption

- Poor absorption of Fats, Protein & Carbohydrate
- More Nutrients available at hind gut (Caeca) for microbes leading to growth & multiplication of pathogenic organisms

NC STATE UNIVERSITY
Slow digestion by the bird leads to more substrate for bacteria



Chronic

Response is to produce more enzymes, immunological reaction and grow a larger intestine. **Costly in nutrient - energy terms.**

Bedford (2002)

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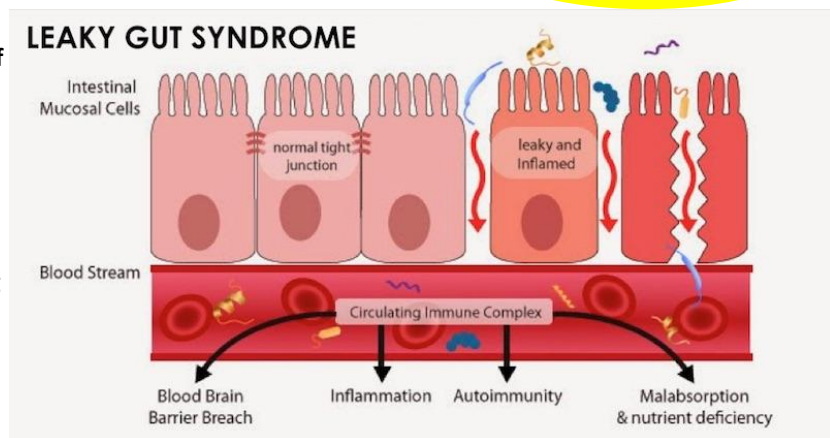
Poor Water Quality Leads to Gut Health Compromise

This leads to further Disruption & Damage of Intestinal mucosa resulting to many more infections

This is called Dysbacteriosis

Unwanted Microbial Overgrowth

- Excess Production of Toxic gas like CO₂, NH₃ & H₂S
- Production of Toxic chemical (Amines); irritates gut
- Inactivation of Bile production affecting Fat absorption
- Excessive Immune reaction leading to Leaky Gut



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Poor Quality Drinking Water & Practical Problems at Farm

- Poor Drinking Water quality with high pH & high TDS leads to Enteritis, diarrhoea & Pasty Vent condition in chicks
- Continuation of the problem cause 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



20230922_120853.mp4



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Poor Quality Water & Practical Problems in Gujarat



5 Day Age



13 Day Age



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Poor Quality Water & Practical Problems in Gujarat



22 Day Age



20230922_120853.mp4



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Effect of Monsoon on Drinking Water Quality

- Effect of Monsoon on underground Drinking Water Quality parameters like Taste, pH, TDS, Hardness, Alkalinity, Dissolved Oxygen & Microbial Contamination varies widely depending on the Nature of the Soil, Land Proximity to River, Presence of Organic matter & Rain volume, etc.
- Poultry in this subcontinent is in between agricultural land and Monsoon is cultivation time when Nitrate contamination in Drinking water is a concern
- Due to Flood & water logging condition of many areas, Microbial contamination reaches its peak in monsoon and Enteritis with Diarrhoea is very common in poultry
- **pH & dissolved Oxygen were found maximum in monsoon –**
Published by H V Vyas & V A Sawant – “Seasonal Variation in Drinking water quality of some Borewell water in urban area of Kohlapur City” - in *Nature Environment and Pollution Technology, Vol VII, No 2 in 2008*
- **The total Hardness, the Total Dissolved Solids (TDS), the Alkalinity and Electrical Conductivity are higher in post monsoon water samples than the pre monsoon samples –** Published by K Karthik, R Mayildurai & S Karthikeyan – A Research on Pre-Monsoon and Post-Monsoon Physio-Chemical Parameters of Groundwater of Velliangadu Vill, Coimbatore, TN, India.

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Liquid Acidifier on Water Quality & Gut Health

- Organic Acids like **Acetic, Formic, Propionic, Citric, Lactic & Butyric acids** not only Reduce Drinking Water pH, but also helps maintaining Optimum Gut Health
 - Field experience shows **Combination gives better results than any single acid**
1. Organic Acid **reduces Water pH** and thus minimizes microbial load in Drinking Water
 2. **Reduce gut pH** which is always under threat from feed intake & poor quality water
 3. Helps maintaining **Gut Microbiome** by favouring the growth of Beneficial Bacteria
 4. Makes the Gut epithelium unfavourable for the pathogenic bacteria like *E coli* & *Salmonella* for adhesion & colonization
 5. **Enhances Villi Height (VH) & Crypts Depth (CD)**; improves digestion & absorption capacity
 6. Reduce unwanted **abdominal Fat** content in chicken
 7. **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., 2000*) leading to the death of bacteria

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Drinking Water Sanitizing Agents

- **Chlorine Dioxide (ClO₂)** – NADCC (Na Diethyl Dithio Carbamate) release HOCl & OCl which hydrolyses bacterial Peptide chain
- **Bromo-Chloro molecules (BCDMH, Bromo-Chloro Dimethylhydantoin)** –
 - a) Dual action, releasing both Bromine & Chlorine
 - b) Slow releasing, has sustained action
 - c) Effective @ much higher pH
 - d) Effective in Presence of Organic matter
 - e) It is effective against some Viruses & fungi
- **Ozone** – The nascent Oxygen molecule of Ozone destroy bacterial cell wall by progressive oxidation. Useful for Hatchery, Processing units



- **IODINE Salt** – i) Act against Bacteria, Fungi & Virus
ii) Effective in Hard Water & have Quick action
- **DDAC (Di-Decyl Dimethyl Ammonium Chloride)** –
 - a) Effective against Bacteria, Fungi, Algae & Virus
 - b) Effective against antibiotic resistant bacteria
 - c) Safe @ higher dosage
 - d) Broad-spectrum & Bactericidal
 - e) Causes disruption of intermolecular interactions & dissociation of lipid bilayers

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What to Do with the Borewell Water in your Farm?

- Borewell shall be away from Agricultural Land
- Borewell shall be near to main Water Tank to avoid long travel
- Water pipeline must be away from Drain/Drain pipeline to avoid microbial contamination
- Installation of Water Treatment Unit (RO) for desired water pH & TDS is the best & economic way to supply safe water to chicken
- In small farms where RO is not feasible, double water Tank is advisable; 1st tank for Chlorine treatment to reduce TDS and 2nd tank for pH control & Sanitization.



From 1st water of 1st Day to Lifting/Harvesting

- Use Liquid Organic Acidifier to Reduce water pH to 6.0 – 6.8
- After 10 minutes use Sanitizer like Chlorine or Bromine Tablet, Iodine or DDAC liquid.

Maintain Drinking Water Hygiene through Cleaning of Watering System regularly

- Tank – after every batch with Bleaching Pow
- Pipeline – Every fortnight with H₂O₂ preparation
- Drinker – Everyday for Manual & Bel (Auto) Drinker and Nipple Cups Weekly

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Water Sanitization – Common Mistakes at Farm

- Use of Water Acidifier alone for Farm water Sanitization
- Use of Sanitizer alone in Farm Water with high Hardness
- Mixing of Acidifier & Sanitizer or Simultaneous Application
- Dose of Acidifier – depends on Farm Borewell Water pH
- Overdosing of Chlorine or Iodine Sanitizer
- No Sanitizer on First day of Chick's Life
- No Acidifier Use on 1st Day & the day of Vaccination
- No Acidifier and/or Sanitizer Use during Medication
- Filling the overhead Tank full capacity & adding Acidifier and/or Sanitizer, may be for 3 days, especially during first few days - Detrimental to New born Chicks
- Contact Time

**Chick
don't like
Any Available
Water**

**Add Acidifier
to make Farm
Water near 6.5**

Wait 10 minutes

**Add Sanitizer @
Recommended
Dose**

Wait 40 minutes

**Use the
Water for
your Chicks**

*No Bromine, DDAC or Iodine Sanitizer
on the Day of Live Virus Vaccination*

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Effect of Water Quality on Liver

- The 2nd important function of liver (besides Metabolism of nutrients, especially fats & fat soluble vitamins) is detoxification of any toxic material entered from outside or produced inside the body.
- In other words, Toxic substances or contaminated ingredients from the feed, Water as well as the toxins produced in the body, are detoxified by the liver.

- The potential toxins include

- Ammonia
- Contaminants like pesticides & carcinogens
- Anti-nutrients like hydrocyanic acid
- Chemicals like heavy metals
- Additives like antibiotics & other medications.

- During the process of detoxification the liver converts the toxins to water-soluble waste products to be eliminated via kidneys and gall bladder.

- Safe Drinking Water is essential for these process.

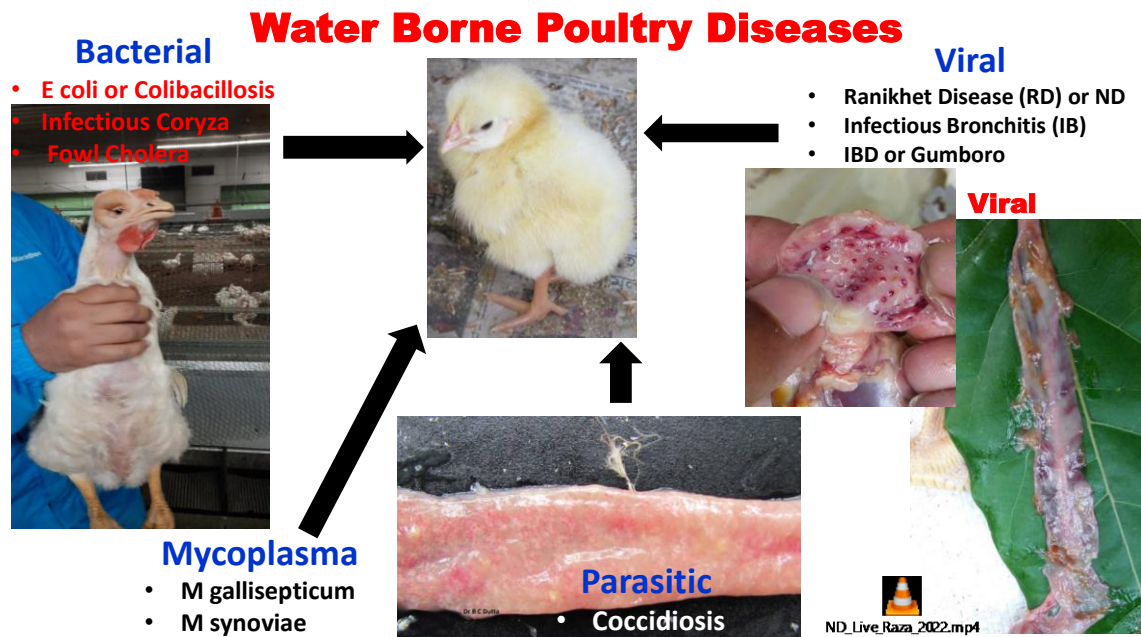


- When Liver fails to do so, FLK or fatty Liver develops resulting Poor Digestion and damage of kidneys while eliminating non-detoxified toxins

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Disease Control through Farm Water Quality Management

Safe Drinking Water to Chicks

Control of Water borne Disease

- Fowl Cholera (*P. multocida*)
- Fowl Typhoid (*S. gallinarum*)
- *E. coli* Infections
- CRD
- Coccidiosis
- ND or RD
- IBD
- IB

Reduced Oxidative Stress and optimum Immune System function > Less Chance of Disease. If Disease comes, will be with reduced severity

Reduced Mycotoxin Effect



Optimum Intestinal Integrity

(Mucous – Microbiome - Tight Junction – GALT)

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

- Necrotic Enteritis
- Coccidiosis
- Infectious Coryza
- Compylobactor

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

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