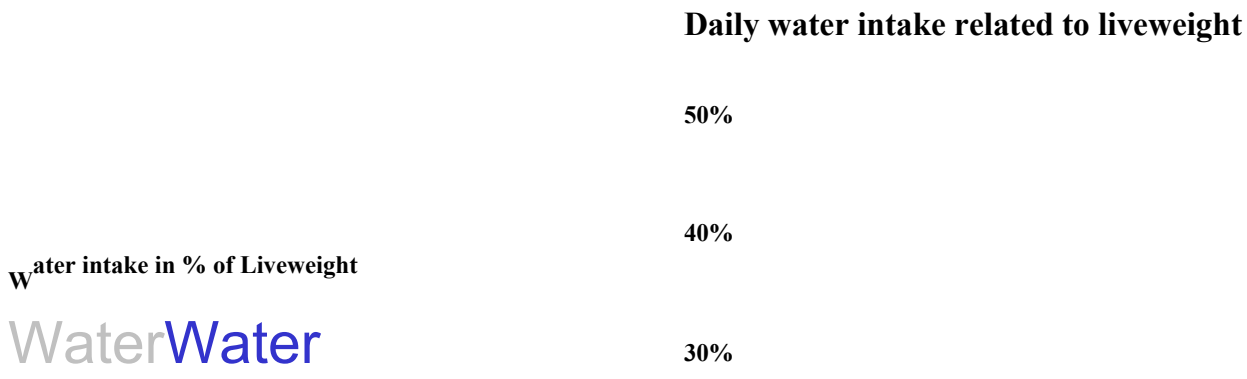
Water quality and sanitation

AL Jazeera 2nd poultry school Amman 17/02/09 Costas Constantinou


Daily water intake related to liveweight
50%
40%
30%
Water intake in % of Liveweight
WaterWater

third of their live-weight

20%

Animal organism

10%

70 % of water

Objectives: satisfying qualitative and

Objectives: satisfying qualitative and

During the first 10 days, chicks are each day drinking more than one third of their live-weight

During the first 10 days, chicks are each day drinking more than one third of their live-weight

During the first 10 days, chicks are each day drinking more than one

0%

0 5 10 15 20 25 30 35 40 45 50

quantitative needs

Broilers age

Broilers age

Broilers age

Water is required for feed intake, nutriment transportation and waste elimination

WaterWater

Water is the most important nutrient for poultry ➢ It is very well accepted the importance of providing sufficient amount of water or adequate access to it ➢ The importance of water quality on performance is often overlooked ➢ Water quality attributes can have a direct or indirect effect on performance. ❖ Bacterial contaminants ❖ Minerals ❖ Other pollutants

Water quality can be evaluated by a number of criteria and standards, but ➢For humans or other species or ➢Based on mortalities and not for optimum performance

Interpretation of the water analysis

WaterWater

Drinking water quality Drinking water quality

1- Chemical quality :

Analysis before opening a new water point, then once a year

Water quality Water quality

Drinking water quality standards for poultry

Drinking water quality standards for poultry

of bacterial contamination
Nitrate is not very toxic
alone below 100 ppm

Nitrite presence is a sign
TDSTDS

Impact of Chemical combinations in the drinking water Impact of Chemical combinations in the drinking water

Excess of chemical in water Excess of chemical in water

➢ NaCl ➢ Ca ➢ Minerals etc

✓ Equipment

Control of excess chemicals related problems Control of excess chemicals related problems

1.Feed adaptation/correction 2.Other sources of water or sources combination 3.Desalination

Feed correction (for Feed correction (for NaClNaCl)

If Na (or Cl) is high in the water supply, reduce sodium (or Cl) in the

feed by reducing (removing): ➢ Salt ➢ Sodium bicarbonate ➢ Avoiding ingredients reach in Na or Cl (fishmeal etc) or

ingredients that interfere with Na or Cl (lasalocid etc)

Similar (up to a level) for other chemicals ➢ Ca, minerals

How much can be replaced? How much can be replaced?

Trial(s) shows that: ➢ Adjustments in dietary levels of Na and Cl should be made

according their levels in the drinking water ➢ The Na (Cl) in the water can replace Na (Cl) in the diet even

completely

In general for Na level in the drinking water above limit point

remove 2 times its level from the feed. (For 500 ppm of sodium in the water reduce feed sodium 1000

ppm= 0.1%)

Desalination Desalination

Works with reverse osmosis Max salinity that can work: 7-7500 mg/l Yield or recovery(% of desalinated water from total water) depends

upon the salinity of the water: from 30-70%

Example for production of 70 tons/day (broiler farm 60000 broilers + cooling pad)

Installation cost:35.000 € Running cost: 0.4 €/ton (23 hours working)

+ double cost from pumping the water (Recovery 45%)

Storage tank

Sand filter UV

treatment

Desalination Desalination

Reverse osmosis membranes

Control panel

Cleanings tank

Antiscalant tank Pressurizing

Dosing pump pump

Capacity measurers

Pressure switches

Safety filtration system

Desalination Desalination

Control panel

Conductivity

Desalination Desalination

Desalination Desalination

TEST Units Normal value Weil Desalination Desalination

173 m 700 conductivity 350 conductivity CATIONS +

BORON ppm(mg/l) 0-0.9 3.52 2.32 2.25 SODIUM ppm(mg/l) 20-195 5222 120 60 POTASSIUM ppm(mg/l) 0-10 8.6 7 5 CALCIUM ppm(mg/l) 0-150 301 31 13 MAGNESIUM ppm(mg/l) 0-80 4.9 11 1

IRON ppm(mg/l) 0.05-0.2 0.01 0.03 AMMONIUM ppm(mg/l) 0.05-0.5 0.2 0.17

ANIONS

CARBONATES-CO3 ppm(mg/l) 0-200 40 40 BICARBONATES-HCO3 ppm(mg/l) 0-200 10 10 SULFATES ppm(mg/l) 0-400 1223 24 4 CHLORIDE ppm(mg/l) 0-300 2978 180 75 NITRATE ppm(mg/l) 0-45 2.8 2.1 PHOSPHATES ppm(mg/l) 0-1 0.06 0.09

T.HARDNESS ppm(mg/l) 0-400 770 309 30 CONDUCTIVITY Ms/cm 0-2500 6250 690 350 TDS ppm(mg/l) 200-1500 4500 430 219

PH 6.5-8.5 8.5 9.6 9.14 TURBIDITY FTU 0-1 0.1 0.1

Broiler Broiler results results Flocks... Flock A Flock B Flock C Days 47.5 44.8 45.5 45.8 B.W 2.2 2.25 2.54 2.53 FCR 1.98 1.95 1.91 1.84 Mortality% 10% 5.35 3.1 3.02 Salty water

Salty water
>5 days
Desalinated No feed
Feed
water adjustments Na-
adjustments Na- Cl

Return on investment per cycle: From growth improvement :60000X0.2kgX1€=12000 € From FCR improvement : 60000X2.5kgX0.15X0.3 €/kg=6750 € TOTAL SAVINGS: 18750 €/ cycle

Desalinated water Cl

Water quality Water quality

2- Bacteriological quality :

The most important. Analysis required twice a year at the entrance of farm and at the end of water pipes

Sampling:

✓ Hygienic conditions: sterilized bottle, gloves, clean and use a flame to disinfect the tap, sample after 10 seconds.

✓ Neutralize any disinfectant (Sodium thiosulfate for chlorine).

✓ Store between 0 and 4°C immediately

✓ Carry the sample to the lab within 12 hours.

Bacteriological Bacteriological quality quality

Risks for broilers Witness of bacterial contamination

Witness of fecal contamination Risk of bacterial infection

Witness of former pipes contamination or poor pipes maintenance

Witness of former pipes contamination or poor pipes and filters maintenance

✓ Labs are looking for fecal contamination witnesses.
✓ A high level of fecal coliform (thermo tolerant) means
there is also potentially dangerous virus and bacteria

Bacteriological quality Bacteriological quality

Drinking water Sanitation Drinking water Sanitation

Drinking water sanitation Drinking water sanitation

➢ Chlorination and other Chemical treatments ➢ Acidification (pH reduction) ➢ UV ➢ Ozone treatment ➢ Others

Chlorination and pH Chlorination and pH

Acid water Alkaline water

HOCL is 100 times more efficient to kill bacteria than OCL.

pH % HOCL % OCL 4.0 100 0 5.0 99 1 6.0 96 4 7.0 75 25 7.4 52 48 7.5 48 52 8.0 22 78 9.0 7 93

A A higher higher chlorine chlorine dose dose can can counteract counteract partly partly a a high high pH pH

Hydrogen peroxide 30 to 50 ppm

pH5.0 5.5 6.0 6.5 7.0 7.5 8.0 Free chlorine (ppm) 0.5 0.5 0.5 0.55 0.6 0.9 1.8 Chlorine dioxide (gas) can also be an alternative on big
farms (higher investment but not sensitive to pH)

Chlorine level checking Chlorine level checking

Test kit to check the free chlorine at the end of the pipe:

Hydrogen peroxide checking Hydrogen peroxide checking

At the end of the pipe:

> 30 ppm of Hydrogen Peroxide.

pH management pH management

Water Water acidity acidity Acid pH pH neutral Alkaline pH Drinking water

✓ Naturally acid waters are generally soft. They contain only a few amount of calcium and magnesium carbonates. These waters increase the risk of poor bone mineralization and are corrosive for metals.

✓ Naturally alkaline waters contain generally large amounts of dissolved minerals. They favor the development of germs and pipes/cups dirtying.

Acid Acid and and tartar tartar High pH Low pH

TARTAR DISSOLVED SALTS

✓ Tartar reduces the nipple flow rate, house bacteria and reduce disinfectant efficiency.

✓ When the pH is low (acid), Calcium and Magnesium carbonates are maintained in their dissolved form.

✓ For the same hardness, an acid water will deposit less tartar than an alkaline water.

Mineral acids, hardness and water pH Mineral acids, hardness and water pH

Sulfuric acid- HCL

Acid volume in

Mineral acids reduce the pH with very low doses.

The required dose depends greatly on water hardness..

Caution: to be handled very carefully + equipments corrosion.

Organic acids, hardness and water pH Organic acids, hardness and water pH

Organic acid

More organic acid is needed to reduce water pH but water hardness has less influence on the quantity required. (buffering properties of organic acids).

Acid Acid & & chlorination chlorination Never mix together acid and chlorine into the medicator

Release of toxic gas.

Acids and water taste Acids and water taste

✓ chicken only perceive salt and bitter tastes.

✓ Salt taste is looked for (but risk of over-consumption!).

✓ Bitter taste reduces water consumption (copper, iron, manganese or some medical treatments).

✓ Organic acids that have a strong taste can hide the bitter taste and thus increase water consumption.

✓ High dose of organic acid reduce water consumption.

Effects on water consumption depends on water characteristics, acid type and dose.

vitro Bio-Chêne Vert (France):

1) Measurement of the anti-bacteria effect on E Coli with various acids and various doses - pH stabilized at 5

Bacteriostatic Bacteriostatic Bacteriostatic Bacteriostatic Bactericidal Bactericidal Not active Not active Not active Formic acid has a strong taste: risk of water consumption drop

Acids Acids and and bacteria bacteria (2/3) (2/3) 2) Measurement of the in vitro bactericidal effect of lactic acid on E Coli in various conditions of pH

Not active Not active Not active Bacteriostatic Bactericidal Bactericidal In Vitro, it is the combination of the pH and a concentration that leads to a bactericidal effect.

Not active Bacteriostatic Bacteriostatic

Acids Acids and and bacteria bacteria (3/3) (3/3) ✓ The pH inside the gizzard is naturally comprised between 2 and 4 (Chlorhydric secretion into the proventriculus).
✓ Drinking water can't be distributed at a lower pH than 3 - 4 without risk for consumption and equipments.
✓ The only effect of a low pH on bacterial and mold development is in drinking equipments and crop (E Coli, Salmonella, Clostridium, mold, etc...)

Effect of drinking water pH on pH inside the crop and the d. gizzar Water pH pH inside the crop pH inside the gizzard 3 4,33 c 3,62 4 4,34 c 3,72 5 4,62 bc 3,70 6 4,96 b 3,95 8 5,57 a 4,16 S. Watkins ✓ Are the good results experienced in the field in some farms (better nutrient assimilation) due to reduced pH or unknown effect of acid molecules (especially organic acids)?

Conclusions Conclusions on on acidification acidification
✓ Acidification is only a supplementary tool helping to provide chickens a good quality drinking water. It will never replace a good maintenance of the drinking system.

✓ Effects of acidification on performance are inconsistent depending on experimentations and farms. There are often benefic on litter quality. The reasons for are not all

well known.

✓ The effect of organic acids is probably higher when hygiene of water and / or feed is poor.

✓ Some organic acids can favor the development of algae (acetic acid).

✓ Acids are:

❖ increasing the efficiency of chlorination with alkaline waters ❖ Reducing tartar deposits on nipples and inside pipes when the water hardness is high.

WATER TANKS WATER TANKS

Water Water consumption consumption = = feedfeed consumption consumption * X* X

Age (jours)

When the water consumption drops, the feed consumption drops as well. The daily following of the water consumption is a good mean to check the feed consumption.

Water Water meters meters

Equipments maintenance Equipments maintenance

Maintenance Maintenance of of water water quality quality

Drinking water at the entrance of the farm can be re-contaminated in the tank and pipes:

PIPES + BIOFILM

WATER

Traitements

HEAT

Development of micro-organisms potentially pathogenic

Development of micro-organisms potentially pathogenic

Examples Examples of of water water recontamination recontamination (CFU (CFU / / ml) ml) Farm Farm Entrance End of nipple line A 2 700 26 600 B 203 000 2 340 000 C 600 282 000 D 0 4 775 000 Source : Watkins 2003

The best quality at the farm entrance can result in the worst quality at the end of pipes

DirtyDirty nipplenipple lineslines (slimeslime)

Tartar Tartar

WhatWhatWhatWhat is is is is pollution pollution pollution pollution pollution -

BiofilmBiofilmBiofilmBiofilm

BiofilmBiofilm

(pollution pollution and and micromicro-organism organism)

Attachment Colonization Growth

MicroMicro-organism organism

+ + Residue

Residue SlimeSlime building building Blockage Blockage

BLOCKAGE BLOCKAGE

BLOCKAGE BLOCKAGE OF OF OF OF THE THE THE THE DRINK DRINK DRINK DRINK DRINK SYSTEM SYSTEM SYSTEM SYSTEM SYSTEM BY BY BY BY BY BIOFILM BIOFILM BIOFILM BIOFILM

Adding of additives, like medicines etc Adding of additives, like medicines etc Adding of additives, like medicines etc Adding of additives, like medicines etc Adding of additives, like medicines etc Adding of additives, like medicines etc Adding of additives, like medicines etc Adding of additives, like medicines etc

Attachment

Colonization Growth

MicroMicro-organism organism

+ + Residue

Residue SlimeSlime building building Blockage Blockage

BiofilmBiofilmBiofilmBiofilmBiofilmBiofilmBiofilmBiofilm is is is is is is is is forming, forming, forming, forming, forming, forming, forming, forming, micro-organism micro micro micro micro micro micro micro organism organism organism organism organism organism organism and and and and and and and and residue residue residue residue residue residue residue residue **Attachment**

Colonization Growth

MicroMicro-organism organism

+ + Residue

Residue SlimeSlime building building Blockage Blockage

Blockage Blockage Blockage Blockage Blockage Blockage Blockage Blockage of of of of of of of of the the the the the the the the drink drink drink drink drink drink drink drink systemsystem system system system system system system **Attachment Colonization**

Growth

MicroMicro-organism organism

+ + Residue

Residue SlimeSlime building building Blockage Blockage

BiofilmBiofilmBiofilmBiofilm BiofilmBiofilmBiofilmBiofilm in in in in in in in in practice practice practice practice practice practice practice practice practice practice practice practice

FilterFilter clogging clogging: check the water pressure : check the water pressure

If the filter is clogged, the difference in water pressure is increased

Medicator Medicator hygiene hygiene

Cleaning protocol between flocks Cleaning protocol between flocks

2 enemies = 2 weapons

MICROBES MICROBES **TARTAR**
TARTAR

ACIDACID **SPECIAL** SPECIAL
DISINFECTANTS DISINFECTANTS

Cleaning of tank and pipes with suitable products during the empty period

Acids for braking tartar
Disinfection

Or Combination

+ mechanical action from water pressure in closed circuit + rinse

During the flock: apply organic acids and drain pipes at least once a week and after each treatment

Cleaning Cleaning procedure procedure

Test 1 Test 1 Test 1 Test 1 Pipeline Pipeline Pipeline Pipeline pictures pictures

pictures pictures

24 hours later

Test 2 Test 2 Test 2 Test 2 Pipeline Pipeline Pipeline

Pipeline pictures pictures pictures pictures pictures

24 hours later

Bacteria

ByBy-pass to flush the pipes pass to flush the pipes withwith highhigh pressure pressure

Flushing pipe

Examples of products that can be used during the flock
Examples of products that can be used during the flock

Water quality is a very important
factor for optimum broiler performance

Water quality is not always the

same even from the same sources. Moreover, there is a tendency to deteriorate, with salt being one of the most popular contaminants

Feed adjustment can be successful

up to a point Desalination can be proven as an

(costly) alternative Water sanitation is ‘one way’ for the broiler and breeder industry

Conclusions Conclusions

Disclaimer Disclaimer

The performance data contained in this document was obtained from results and experience from our own research flocks and flocks of our customers. In no way does the data contained in this document constitute a warranty or guarantee of the same performance under different conditions of nutrition, density or physical or biological environment. In particular (but without limitation of the foregoing) we do not grant any warranties

regarding the fitness for purpose, performance, use, nature or quality of the flocks. HUBBARD makes no representation as to the accuracy or completeness of the information contained in this document.