Biocide Treatment of Poultry Drinking Water: Results of an Extensive Trial

Robert Wilson BSc M.W.M.Soc.

1.0 Summary

Silver Stabilised Hydrogen Peroxide is a broad-spectrum disinfectant with particular efficacy in removing and treating biofilm and used for treating poultry drinking water systems.

The cost effectiveness of it has been demonstrated by a 5 crop trial on 2 separate broiler farms each with 8 sheds. Silver Stabilised Hydrogen Peroxide treatment, produced on average an extra 8-10 tonnes kill weight compared with untreated houses. Reduced mortality added a further 4.5 tonnes. The treatment reduces the Food Conversion Ratio (FCR) by over 3% and this also improves the EPEF.

These results have been confirmed by a similar trial conducted in Turkey.

While there are many products available in this market Silver Stabilised Hydrogen Peroxide must be regarded as the treatment which has been most widely applied, has the most documented proof of efficacy and has achieved the greatest documented savings. Use of the product brings a minimum of 20 times return on investment.

2.0 Introduction

Most of the poultry industry is now conscious that the presence of pathogens in broiler house drinking water, will result in higher bird mortality and birds taking longer to get to kill weight. Poor quality water equates with poor bird health.

While chlorine (bleach) has been considered as the universal water disinfectant it is relatively ineffective in broiler house situations where pathogen containing biofilms grow in the drinking water supply lines. Chlorine is poor at removing and controlling biofilms growers have considered using chlorine dioxide as a treatment chemical as this chemical can remove and treat biofilm. For practical reasons (expensive dosing and control equipment) many farmers have stopped using chlorine dioxide and considered the use of hydrogen peroxide and more recently silver stabilised hydrogen peroxide as a control treatment.

The choice of a biocide should be major consideration in any poultry house biosecurity programme as the benefits of choosing the correct chemical can have a marked effect on the health of the chicken and the profitability of the crop.

It is worthwhile looking at the different disinfectant treatments which have been used to treat poultry house water and this is done in the table below and also remembering that most pathogens breed in biofilms and the removal and treatment of biofilms is important to the success of any biocide treatment. Chlorine and Peracetic acid will remove upper layers from biofilm but fail to get penetrate the obdurate surface layer which bonds the biofilm to the substrate.

Disinfectant	Kill Efficacy	Biofilm Removal Efficacy	Dosing Equipment Cost	Chemical Cost	Comment
Chlorine (bleach)	8	2	1	1	1. Excess chlorine causes animals to lower water intake[1] 2. Chlorine has limited effect on biofilm where most of the pathogens dwell. 3. Chlorine is not beneficial to health of poultry
Chlorine Dioxide	8	7	10	10	1.Excess chlorine dioxide causes animals to lower water intake[1] 2. Dosing equipment is prohibitively expensive.
Peracetic Acid	6	2	1	10	This product is not a contender – poor biofilm remover
Hydrogen Peroxide	2	2	1	1	1. Poor biofilm remover
Stabilised Hydrogen Peroxide	4	6	1	10	1. Varying degrees of biofilm removal capabilities 2. Most of claims are unproven
Silver Peroxide	5	8	1	10	Proven to give best results over a number of crops

1.Drinking Water Quality for Poultry – North Carolina College of Agriculture and Bioscience
2. Chlorine Dioxide is a gas which needs to be prepared by mixing two chemicals together safely

3. Silver Stabilised Hydrogen Peroxide Treatment

Silver Stabilised Hydrogen Peroxide is now being used for potable water treatment in North America. It is used extensively in Belgium, the Netherlands and Germany for Broiler house drinking water treatment and is the product of choice for poultry grow house water disinfection. in Turkey where trials have already been carried out which indicate that Silver Stabilised Hydrogen Peroxide treatment could result in the elimination of antibiotics from the broiler house.

While the industry is slowly waking up to the fact that water treatment may be important there is still a tendency to look at product cost rather than crop profitability as the method for selecting a biocide.

Silver Stabilised Hydrogen Peroxide is a new water disinfectant. It was invented in 1980 and it is slowly coming of age at a time when there is a requirement to powerful yet environmentally acceptable disinfectants. The product is used for legionella control, it controls biofilms in plant system irrigation lines and is used in North America as a chlorine replacement in potable water.

Dr Carlson[2] states that water is the single most important nutrient to life without it no metabolic or physiological process can take place. It is required in much larger amounts than any other nutrient and constitutes up to 80% of body weight depending on the age and fat content. Water is necessary for the movement of nutrients to the cells, mineral balance, and protection of the nervous system and body temperature control. His paper concludes that animals need a sufficient supply of good quality sterile drinking water.

In a broiler house vitamins and vaccines are transported to the birds via the drinking water system. The system needs to be clean and biofilm free to ensure that the treatments actually get to the birds.

Silver Stabilised Hydrogen Peroxide treatment ensures that birds drink clean sterile water with residual hydrogen peroxide content and that there is no possibility of their ingesting water with a high microbiological count.

The most convincing argument for using any product is the economic one. Extended trialling with a large poultry producer (2 houses / 6 crops per house) indicated a 20 times return on investment. Similar returns have been demonstrated on a 420 sow pig unit. The product when applied to water reduces mortality and increases weight gain ensuring healthier animals get to kill weight faster.

[2] Water the Essential Nutrient – Dr Marcia Carlson, Swine Nutrition Specialist, University of Missouri-Columbia.

4. Some Practicalities

Some of the early attempts to use Silver Stabilised Hydrogen Peroxide as a broiler house water treatment were compromised by using substandard dosing equipment. The chemical should be dosed in proportion to the water flow to the drinkers using good quality equipment. A good dosing system will cost between £500 and £1,000.

When treatment is first introduced Silver Stabilised Hydrogen Peroxide should be added to give a 100 ppm hydrogen peroxide level in the water. Ideally this level should be introduced into the system during a clean down period when the broiler house is empty and left there until the house is restocked. The water should be run to all the outlets to ensure that every part of the water system is sanitised. This should be checked at the furthest drinking point on each line using hydrogen peroxide test strip. The water should then be flushed through on a daily basis without further addition of Silver Stabilised Hydrogen Peroxide. When the new crop is introduced the hydrogen peroxide level should be measured. The level of Hydrogen peroxide in the water should be >10 ppm and < 15 ppm throughout the crop cycle. If the water is supplied from a tank it may take one or two days before this range is achieved. When this level has been achieved the dosing system should be started and adjusted to ensure a consistent level of 10ppm to 15 ppm hydrogen peroxide in the water.

In dirty systems use of Silver Stabilised Hydrogen Peroxide may result in biofilm sloughing off. Lines may need to be cleaned and drinker blockages removed.

If antibiotics are used it is prudent to stop Silver Stabilised Hydrogen Peroxide dosing. The treatment does not need to be stopped during the dosing of vitamins or other supplements.

There is no further need to carry out pre-disinfection as long as the shed and water supply are in continuous use. If a shed and water system are not used for some time a pre-disinfection should be carried out.

Appendix 1
Results from Broiler House Trials

Trial Conditions
A comprehensive trial of Silver Stabilised Hydrogen Peroxide was carried out on two leading broiler houses of a major poultry producer. Each site had 8 sheds, with similar drinking water systems. The water systems of 4 of the houses were treated with Silver Stabilised Hydrogen Peroxide as described. The other houses were not treated.

The Group Planning department gave information on the number of birds uplifted from the individual sheds and the corresponding weight of uplift. This allowed an average bird weight to be calculated for treated and untreated sheds. On occasions when multiple uplifts were made from a number of sheds and the total weight was recorded. This was averaged and the average weight used.

The Planning Department also issued information on food consumption during the trial allowing the FCR to be calculated. The calculated figures allowed us to obtain an EPEF for the individual houses.

Mortality figures were taken directly from the Crop logs and averaged.

This situation continued for 5 different crops allowing a good comparison to be made between treated and untreated sheds.

Trial Conclusions
The main conclusions of the trial were.

1. Silver Stabilised Hydrogen Peroxide improves the live weight gain, particularly on cocks. (The average live weight gain was 0.2g/bird per day (0.8g/bird per day at Broiler House A and zero at Broiler House B) and 1.6g/bird per day on cocks) 1.2g / bird per day at Broiler House A an 1.9g per bird per day at Broiler House B.

   The real weight gain is equivalent 8-10 tonnes per crop (assuming a 200 000 bird unit with a 50/50 pullet /cock split)

2. Silver Stabilised Hydrogen Peroxide reduced pullet mortality 0.4% (Broiler House A) and 0.3% (Broiler House B) and cock mortality by 2% (Broiler House A) and 0.6% (Broiler House B) This is equivalent to 2400 additional birds per crop in boiler house A and 900 additional birds in Broiler house B. This would add a further 4.5 tonnes per crop
3. Silver Stabilised Hydrogen Peroxide treated houses had an improved Feed Conversion Ratio (FCR) – 3.6% improvement for broiler house A and 3.1% improvement in house B and as a consequence the European Poultry Efficiency Factor (EPEF) was higher in the treated houses on both sites.
4. The cost of Silver Stabilised Hydrogen Peroxide was calculated at 0.15 pence, per bird.

In Turkey successful trials have been carried out where Silver Stabilised Hydrogen Peroxide treatment has replaced the use of antibiotics. (See Appendix 2)

Table 1 Summary Information from Trials

Comparison	Broiler House A Treated	Broiler House A Untreated	Broiler House B Treated	Broiler House A Untreated
Pullets(Px)– weight improvement g/bird/day	0.8	-	No improvement	
Cocks(Cx) – weight improvement g/birds /day	1.2		1.9	
Px Mortality (%)	2.34	2.72	1	1.3
Cx Mortality (%)	5.04	7.04	3.2	3.8
FCR (note 3)	1.88	1.95	1.86	1.92
EPEF(note 3)	302	294	326	305

Note 1 The average weight and average age for the 4 treated and 4 untreated houses on each site was evaluated and the weight difference between the treated and untreated houses and averaged to give the average live weight improvement.
Note 2 The mortality figures are an average of the composite mortality results given in Table 2
Note 3 FCR – the food conversion ratio and the **EPEF** the European Poultry Efficiency factor are universally recognised indicators of crop performance.
FCR = total weight of feed consumed / gross live weight over weighbridge – The lower the FCR the higher the efficiency
EPEF = (100 - % mortality x average live weight) x100/FCR x Average age

Appendix 2

COST ANALYSIS IN A TURKISH CHICKEN SHED

This test was carried out at 'Erpilic' one of the biggest poultry producing companies in Turkey.

Two sheds: Capacity of each is 30,000 chickens.
Food consumption was identical for both sheds.

Shed A: Control Shed
Shed B: Silver Stabilised Hydrogen Peroxide treated shed

Shed A:
Description Extra Costs
Use of Antibiotics in the control shed €300.00
Disinfection and removal of biofilm €30.00
TOTAL COSTS €330.00

Shed B:
Description Extra Costs
Use of Silver Stabilised Hydrogen Peroxide €100.00
TOTAL COSTS €100.00

The water distribution system had to be disinfected and biofilm removed in Shed A. This did not have to be done in Shed B.

In the test for Shed B, Silver Stabilised Hydrogen Peroxide was used for the disinfection of the surfaces (1%), air (1000ppm), biofilm removal (1%) and continuous drinking water treatment (30ppm). Because Silver Stabilised Hydrogen Peroxide was used continually, the water distribution system stayed clean.

Results
- A gain of 128g/chicken against the control Shed A was ascertained.
- 0.3% lower mortality rate was ascertained for Shed B against the control Shed A.
- €4000.00 extra profit from Shed B due to the extra weight of the chicken and the lower mortality rate.

Description Costs
Extra profit from Shed B €4000.00
Total extra costs Shed B €100.00 -
Total savings (antibiotics & disinfection) €330.00

TOTAL SAVINGS €4230.00

Table 2 Results of Individual Broiler House Sheds

House A

	Crop	1		2		3		4		5		6		7	
		H 1-4	H 5-8	H 1-4	H 5-8	H 1-4	H 5-8	H 1-4	H 5-8	H 1-4	H 5-8	H 1-4	H 5-8	H 1-4	H 5-8
1	Pullets wt.(kg)	1.9	2.04	2.25	2.17	2.28	2.21	2.21	2.1	2.1	2.1	2.02	2.1	2.2	2.01
2	Average age(days)	41.4	43.3	43	42	43.4	42.4	43.7	42.6	43.1	43	40.3	40.9	42.6	40.08
3	g per day (1 / 3)	45.8	47.1	52.3	48.8	52.5	52.1	50.5	49.1	48.7	48.8	50.12	51.3	51.6	49.2
4	Mortality (%)	2.5	1.92	2	2.4	1.9	2.2	2.4	2.2	1.6	2.9	2.3	2.1	1.5	1.8
5	Cx average weight (kg)	3.19	3.01	3.55	3.36	3.7	3.55	3.64	3.55	3.66	3.79	3.7	3.75	3.52	3.5
6	Ave age (days)	53.7	50.9	53	52.7	55.5	55.4	55.5	55	55.8	57.8	54.5	54.6	52.5	52.6
7	g per day (5/6)	59.4	59.1	67	63.7	66.7	64.1	65.5	64.5	65.5	65.5	67.8	68.7	67	66.5
8	Cx mortality	5.9	5.2	4.7	5.3	4.8	6.7	4.6	5.2	5.0	8.4	6.1	5.4	4.7	4.2
9	FCR							1.81	1.98	1.91	1.98	1.94	1.89		
10	EPEF							310	281	304	290	292			

House B

	Crop	1		2		3		4		5		6		7	
		H 1-4	H 5-8	H 1-4	H 5-8	H 1-4	H 5-8	H 1-4	H 5-8	H 1-4	H 5-8	H 1-4	H 5-8	H 1-4	H 5-8
1	Pullets wt.(kg)			2.29	2.27	2.23	2.25	2.14	2.14	2.04	2.04	2.3	2.3	2.2	2.23
2	Average age(days)			43.3	43.1	42.7	43.4	42.2	42.4	40,8	40.3	43.5	43.3	41.8	42.2
3	g per day (1 / 3)			52.8	52.6	52.2	51.8	50.7	50.7	50	50.6	52.8	53.1	52.6	52.8
4	Mortality (%)			1.1	1.6	1.2	1.9	1	1	0.9	0.9	0.8	1	0.9	0.85
5	Cx average weight (kg)			3.75	3.75	3.66	3.67	3.67	3.67	3.62	3.55	3.74	3.56	3.46	3.56
6	Ave age (days)			54.4	55	54.7	58.2	55.1	56.1	54.4	54.7	55	53.3	52.7	52.9
7	g per day (5/6)			68.9	68.2	66.9	62.2	66.6	65.4	66.5	64.8	68	66.8	65.7	67.3
8	Cx mortality			3.6	4.3	4.2	5.6	3.4	3.7	2.4	2.6	2.5	2.9	2.6	2.9
9	FCR			1.85	1.88	1.88	N/D	1.86	1.94	1.84	1.9	1.88	1.94		
10	EPEF			325	316	311	N/D	316	295	314	313	322	298		