CREDENCE
Technical Report

For Farm Hygiene

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I N D E X

Appendices

1.0 INTRODUCTION TO CREDENCE

CREDENCE are effervescent tablets which, when dissolved in water, produce disinfectant solutions that have been verified effective against known pathogens encountered in farming environments:

- CREDENCE tablets are used for the disinfection of water and water systems
- CREDENCE tablets are used for the disinfection of surfaces and equipment on farms.

2.0 WHY DISINFECT?

Very simply, it is vital to include a disinfection programme as part of good animal husbandry on the farm, to prevent disease in livestock, staff and consumers. Disease outbreaks dramatically affect the profitability and the livelihood of farming enterprises:

- they cause death or poor growth in stock
- they lower breeding/laying/growing performance and increase feed conversion
- they lead to high medical costs.
- they cause safety concerns for staff

There are also obligations and legal requirements to protect consumers from possible adverse effects due to the consumption of unsafe foods.

The difficulty is that the causes of these diseases - microorganisms - are not visible. By the time the clinical signs are evident in the livestock, it is often too late. Remedial actions are costly in terms of lost output and medical bills. Often the infections are sub-clinical with no obvious visible signs of disease, but as the animal fights these infections there will be a simultaneous loss in performance (e.g. lower weight gains, high feed conversion, poor quality produce), which will reduce the profits to the farmer. Add to this the continual emergence of new strains of microorganisms resistant to vaccines and antibiotics, which produce ever increasing medical costs.

Good animal husbandry demands that there is control of these invisible enemies that cause disease. Control helps produce healthy livestock, safe food and increased profitability. Today a system known as HACCP is recognised for providing the most scientific and secure method for designing programmes that protect livestock from disease, and produce safe food.

3.0 WHAT IS HACCP?

HACCP stands for Hazard Analysis Critical Control Points. The HACCP system was developed in the US during the 1960's for NASA (National Aeronautics Space Administration), as a scientific means of preventing food safety problems on manned space flights. The HACCP system incorporates 7 principles, details of which are included in Appendix 1. Good husbandry, incorporating HACCP system principles, assures that profitable products are produced to the highest quality standards.

The first step is to identify and assess potential hazards on the farm. This would include a review of the site and premises; the inputs (e.g. stock, food, water); all production and storage operations; and transportation. This analysis will help identify particular points where action can be taken to eliminate, or reduce to non-hazardous levels, the risks (physical, chemical and microbiological) to livestock, staff and consumers. These points are known as Critical Control Points (CCP's). Good animal husbandry ensures that all potential hazards are continually under control at the identified CCP's, by introducing good farming practices (GFP's), (Appendix 2).

4.0 CREDENCE AND HACCP

Control of microbiological hazards in the environment is essential for the protection of livestock, staff and consumers. One of the principal means of achieving this control is by the implementation of effective disinfection programmes. These programmes must:

- use safe, wide-spectrum disinfectants, verified to kill the key microorganisms
- be practical, and easy to understand and implement.

CREDENCE disinfection programmes have been designed and validated to be consistent with HACCP system principles, by addressing disinfection needs at critical control points.

These programmes address the needs for:

- the provision of safe drinking water,
- the elimination of pathogenic microorganisms in the environment, (CREDENCE)

These topics will now be considered in the following sections of this report.

5.0 THE PROVISION OF SAFE WATER USING CREDENCE®

Water is essential for life. It plays a critical role in digestion, respiration, absorption, circulation of nutrients, excretion, hydrolysis etc. As more pressure is placed on farmers to improve quality standards greater attention is required for all inputs to the farm that may affect the biosecurity. Water can be a carrier of disease, if the quality is poor. Many pathogenic microorganisms are transmitted through water e.g. *E. coli, Salmonella, Campylobacter, Vibrios*, Hepatitis, *Entamoeba,* etc. This vital nutrient is a most important potential hazard and yet farmers often overlook this Critical Control Point. During the early stages of the production cycle, when water intake is low and sheds are heated, there can be a significant increase in pathogens carried in the water. Similarly, towards the end of the growing cycle, the problems can increase due to a build-up of contamination in the sheds and from the livestock itself. The quality of the water will affect feed conversion ratios, weight gains, layer performance, shell and meat quality etc.

Drinking water quality must be monitored and controlled. Quality standards are known and published; an example is given in Appendix 5. But how can a farmer be assured that he has microbially safe water?

5.1 The Validated CREDENCE Method for Provision of Safe Farm Water.

Medentech has extensive experience in the use of its products for the provision of safe drinking water for human consumption. Indeed, this experience stretches back over 10 years. Many millions of tablets have been used for this purpose, often in difficult and remote parts of the world.

Medentech is a major supplier of water disinfectant tablets to the United Nations and other organizations. The effectiveness and safety of the product is known and assured.

In validating the effectiveness of the product, the basic criteria from the World Health Organization Guidelines for Drinking-water Quality (1) for human consumption have been used. In summary, water quality standards should ensure:

- No faecal (*E. coli* or thermo tolerant), coliform counts in a 100ml sample
- No total coliform counts in a 100ml sample.

Where chlorination is used to produce safe water there should be:

- a residual concentration of free chlorine $\geq$ 0.5 mgs/litre (ppm.)
- but not greater than 5mgs/litre (ppm.)

To validate the effectiveness of CREDENCE, Medentech has undertaken many trials throughout the world, in a wide variety of water sources including:

* piped water
* well water
* river water
* pond water
* rain water
* clear water
* high turbidities
* faecal contamination
* varied pH's

These independent studies (2,3,4,5,6,7,8,9,10,11,12,13,14) clearly verify the effectiveness of CREDENCE in very adverse conditions, meeting the water quality standards required, and enabling Medentech to produce assured guidelines for water disinfection on the farm (Appendix 3 for poultry and Appendix 4 for swine).

In support of these studies, further evaluations specifically undertaken in the farming environment, reviewed other factors, including feed conversion efficiencies, weight gains, incidence of *Salmonella*, meat quality etc. These evaluations are summarised in sections 5.2 to 5.5 as follows:

5.2 Poultry Trials

5.2.1. Study on a Broiler Chicken Farm (15) - Water Quality

In a broiler chicken farm of 180,000 birds per cycle, and with a background of faecal contamination in the water supply, two coops were chosen at random to evaluate the effectiveness of CREDENCE.

Table 1 presents the results of the tests:

Table 1

	Coop 1		**Coop 2**	
	Before treatment	35 minutes after treatment	Before treatment	35 minutes after treatment
Aerobic mesophilic bacteria	77,000 CFU/l	0 CFU/l	680,000 CFU/l	0 CFU/l
Total count of coliforms per litre	88 CFU/l	0 CFU/l	210 CFU/l	0 CFU/l
Production of foul smell	YES	NO	YES	NO
Gelatine liquefaction	YES	NO	YES	NO
Pigment production	YES	NO	YES	NO
Identification of	*Aeromonas hydrophila*	---	*Citrobacter freundii*	---
Activity	Not disinfected	Disinfected	Not disinfected	Disinfected

Before the addition of CREDENCE, both coops (sheds) had high counts of aerobic mesophilic and coliform bacteria in the water supply. After treatment the counts reduced to zero.

The study concluded with the following advantages:

"a) Dosage is very simple, and the tablets use very little space.

b) The product presentation does not need special storage, and its transportation is simple.

c) The mode of usage is extremely user-friendly for farm personnel to understand the way it works.

d) Lastly, it is very safe and not very aggressive for the user."

5.2.2 Studies on Egg-laying Performance (16,17)

In the first study, two similar chicken houses were chosen, containing approximately 3,000 chickens. One house acted as a control where the chickens received untreated drinking water. The treated group received water that was filtered ("Oddis" filter) and disinfected with CREDENCE using a dosimeter. The final concentration immediately after the pump was 2 mg/l available chlorine.

The percentage of birds laying and the percentage of breakages is given in Table 2:

Table 2

MONTHLY AVERAGES				
	Treated Group		Control Group	
Month 1990/1991	% laying	% breakages	% laying	% breakages
December	73.0	2.9	66.6	3.4
January	60.0	2.8	64.7	3.6
February	65.1	3.1	64.2	3.6
March	62.1	3.6	58.3	3.8

There was a better laying performance, with fewer breakages, with the treated group.

In a second study, 150 laying birds (Lohman) were divided into two equal groups, each of 5 replicas of 16 layers (each cage having 3 birds). The hen housing was equipped with new coops and a new (Plasson) dripper drinking system. The control group received untreated drinking water, and the experimental group received water treated with CREDENCE. The tablets were added to closed plastic tanks situated on the roof of the chicken house. The levels of egg laying, egg breakage, food and water requirements, and shell qualities were measured over a 4 month period, with the following results (Tables 3 and 4):

Table 3

Monthly Averages								
Month	**Treated Group**				**Control Group**			
	% laying	**% breakages**	**Food intake g/hen/ day**	**Water intake ml/hen/ day**	**% laying**	**% breakages**	**Food intake g/hen/da y**	**Water intake ml/hen/ day**
1	67.70	5.20	122	223	71.8	4.90	120	232
2	71.90	6.74	140	245	71.5	7.17	140	238
3	67.70	10.00	140	267	62.0	6.30	140	245
4	63.40	10.14	140	289	57.5	7.62	140	251
Ave.	67.60	8.02	135	256	65.7	6.49	135	241.5

Decrease in laying performance over 4 months: Treated Group – 6.4% Control Group – 21.8%

Table 4

Egg Weights and Shell Quality				
	Egg weight g	**Shell weight as % of egg**	**Shell Thickness mm**	**Shell Density mg/cm^2**
Treated Group	69.65	9.59	0.376	84.0
Control Group	68.70	9.54	0.376	83.5

There was a significant difference reported in the fall-off of the laying performance - 21.8% for the control group compared to 6.4% with the treated group. It was reported that the increase in breakages might be due to the larger quantity of eggs produced by the treated group and their higher average weight. Food intake was similar for each group. The marginal increase in water intake with the treated group demonstrates a tolerance to CREDENCE treated water. Bacteriological examination of the drinking water showed significant differences (Table 5):

Table 5

	Control Group	**Treated Group**	
	Orgs/ml	Orgs/ml	% Reduction
Total Bacteria Count	1 x 10^7	1 x 10^2	99.999%
Total Coliform Count	1 x 10^2	0	100%

The report concludes *"that the use of CREDENCE Disinfectant Tablets, for the addition of Troclosene Sodium (NaDCC) to the water in the Plasson drinking system, improved the quality of the drinking water to the chicken coops and maintained a suitable level of disinfection. It is also evident that there was an improvement in the performance of the laying hens. In the light of the results of this and previous studies, further investigation is warranted"*.

5.2.3 Study on a Broiler Chicken Farm (18) - Weight Increases/Mortality

Two identical chicken coops (houses) contained 10,000 and 8,000 chicks respectively, at the start of the trial. The same water source was used for the trial, and the coops and drinking apparatus cleaned and disinfected before commencement. Both groups were vaccinated against Newcastle Disease at one day old, and received a Gambin injection at 10 days old. In week 5 both groups received a Gumboro inoculation.

For Coop A the water was treated with CREDENCE. Coop B received untreated water and acted as the control group. Table 6 summarises the results.

Table 6

	Coop A Treated Group		Coop B Control Group	
Week	**Weight g**	**Mortality**	**Weight g**	**Mortality**
1	144	86	140	83
2	360	84	350	60
3	600	43	500	50
4	1050	59	800	167
5	1250	286	1100	586
6	1650	43	1600	22
7	1821	53	1673	47

The average increase in weight was almost 9% for the treated group when compared to the control group. Mortality was reported as 2.8% for the treated group and 7.3% for the control group.

5.2.4 Broiler Study (19) - Productivity/Meat Quality/Microbiological Condition

Six hundred one-day-old cockerels of "Ross" breed were used in the trial, after a 14 day-long adjustment preliminary period. On day 14 each animal was individually weighted and the plus/minus variants excluded from the trial. Based on data from bacteriological examination for *Salmonella* sp. by cloacal swabbing, the basal state of contamination (infection) of the chicken was determined. In the drinking water of some groups, 10^8 orgs./ml. of a 24 hour-culture of *Salmonella enteritidis* was mixed every day as an artificial super-infection challenge. The drinking water was treated with sodium dichloroisocyanurate in concentrations of 5 and 20mg/l available chlorine between days 21 - 49. Changes in the chickens' live weight, feed consumption and clinical state were followed-up continuously. The birds that died during trial, and the randomly selected animals from each treatment, were necropsied at the end of the experiment and histopathologically studied. After slaughtering on day 49, ten average, representative chickens were examined for carcass/meat quality and bacteriological status, (mainly for the presence of *Salmonella* sp.).

Six groups were arranged according to *Salmonella* infection and treatment regime as follows:

Group 1	Control – ***Salmonella*** free
Group 2	Naturally *Salmonella* free Artificially infected with *Salmonella* challenge Treated with 5mg/l CREDENCE
Group 3	Basal Contamination with *Salmonella* Artificially infected with *Salmonella* challenge Treated with 20mg/l CREDENCE
Group 4	Naturally *Salmonella* free Artificially infected with *Salmonella* challenge Treated with 20mg/l CREDENCE
Group 5	Basal Contamination with *Salmonella* Treated with 20mg/l CREDENCE
Group 6	Basal Contamination with *Salmonella* Treated with 5mg/l CREDENCE

The effect of treating the drinking water with CREDENCE on weight gains, feed conversion efficiencies (FCE) and mortality is given in Table 7

Table 7

Group		Weight Gain		F C E		Mortalities	
No	**Code**	**Mean g**	**%**	**Ave kg/kg**	**%**	**Died**	**Culled**
1	SF (control)	1570.0	100.00	2.39	100.00	8	0
2	ASC/5mg/l	1679.31	106.94	2.11	88.24	2	3
3	BSC/ASC/20mg/l	1657.65	105.61	2.03	84.94	2	1
4	SF/ASC/20mg/l	1717.23	109.49	1.93	80.75	2	4
5	BSC/20mg/l	1389.37	88.47	2.28	95.40	3	6
6	BSC/5mg/l	1618.67	103.12	2.15	90.00	3	3

Code:
SF: *Salmonella* Free
ASC: Artificial *Salmonella* challenge (10^8orgs/ml) (CREDENCE)
BSC: Basal *Salmonella* Contamination
5/20ppm:mgs/litre available chlorine

During the 4 week administration of CREDENCE, cocks drinking the treated water had significantly greater weight gains than the control, (with the exception of Group 5). Groups 4 (9.49% greater weight gain) and 2 (6.94%) giving the best results. F.C.E. was also better in all treated groups than in the control; Groups 4 and 3 giving the best results.

Salmonella infectivity was measured by taking cloacal swabs, with the following results:

Group	Code	Salmonella Infectivity
1	SF (Control)	100% Negative
2	ASC/5mg/l	80% Negative (32 out of 40)
3	BSC/ASC/20mg/l	85% Negative (17 out of 20)
4	SF/ASC/20mg/l	80% Negative (16 out of 20)
5	BSC/20mg/l	74.2% Negative (89 out of 120)
6	BSC/5mg/l	78.4% Negative (94 out of 120)

The number of *Salmonella* carrier birds (100% in Groups 2 to 6) was reduced by 74.2% up to 85%. There was no significant difference between the 5 and 20mg/l dosages. All birds treated with 20mg/l showed evidence of diarrhoea, (especially Group 5).

The meat quality was assessed by measuring the consistency and water-binding capacity of breast and thigh samples. Boiling and roasting tests were also carried out on breast and thigh meat samples, and scored according to tenderness. The chickens were 47 - 48 days old. Meat samples of the second group showed bigger diameters and better consistencies. The second group also produced more tender meat. Meat quality was better in the 5mg/l treated groups than with the 20mg/l treated groups.

The report concluded that, *" After evaluating the results of the completed trial, one can state that continuous treatment of drinking water by the addition of sodium dichloroisocyanurate significantly improved both the average weight gain and the feed conversion efficiency of broiler chickens. In case of a medium or strong oral Salmonella loading (challenge), when this reflects the actual production circumstances, the 20ppm* (mg/l) *sodium dichloroisocyanurate concentration gives better results that the 5ppm* (mg/l). *If the oral Salmonella intake is very low, the higher (20p.p.m.) concentration of active compound may disturb the balance of the intestinal flora. Consequently, in these circumstances, the use of the 5p.p.m. sodium dichloroisocyanurate concentration is advisable. The meat and carcass qualities were not adversely affected by the drinking of water containing sodium dichloroisocyanurate. Indeed, the lower concentration (5 ppm.) even improved the consistency and tenderness of meat."*

5.2.4 Study on a Turkey Farm - Residual Chlorine Levels / Water Quality (20)

Although the mains water supply to the turkey farm was potable on arrival, the quality was not of an acceptable standard at the end of the drinking line due to pollution in the lines. The effect of adding CREDENCE to the water tank was evaluated, with respect to the residual chlorine levels achieved at the end of the line, and on the water quality.
One CREDENCE1000 was added to the 1600litre tank, to give a "free" chlorine concentration of 3.1mg/l available chlorine. The actual dosage in the tank had an initial measurement of 1.5mg/l, due to the reaction of CREDENCE with the organic matter in the tank and pipework. However, a residual "free" chlorine level of 0.3mg/l was still found at the end of the line two hours after treatment. After two hours an additional half a tablet was added to the 500litres remaining in the tank, equivalent to a dosage of 5mg/l "free" chlorine. The actual dosage in the tank was measured at 5mg/l available chlorine and at 0.5mg/l at the end of the pipeline 90 minutes later.

Table 8

Time	One Tablet in 1600 Litres (Free Chlorine in mg/l)	Line End (Free Chlorine in mg/l)
10.45	1.5	
11.15	1	
11.30		0.25
11.40	0.75	
12.15	0.5	
12.20		0.25
12.35		0.30
15.30	Addition of ½ tablet to remaining 500 litres	
15.40	5	
15.55		1.0
16.20	3	
16.30		0.5
16.55		0.5

The bacteriological analysis shows that the water quality is potable on arrival at the farm. Further analysis indicates pollution in the water distribution system. Addition of the CREDENCE reduced the levels of microbiological contamination:

Table 9

Microorganisms	**Mains Water**	**Water Quality at End of the Line**		
		Before Treatment	**After Treatment**	
Coliforms/100ml	0	50	0	0
Thermoresistant Coliforms/100ml	0	30	0	0
Faecal *Streptococcus*/100ml	0	0	0	0
Microorganisms revivable after 48h at 37^{o}C/1ml	0	57	32	6
Microorganisms revivable after 72h at 22^{o}C/1ml	0	490	220	4
Sulphite Reducing Anaerobic Spores/20ml	0	0	0	0

5.3 Swine Trial

5.3.1. Study on an Integrated Pig Unit - Water Quality/*Salmonella* Reduction (21)

A 300 sow integrated pig unit had two major concerns:

- Repeated high *Salmonella* ELISA scores
- High Total Bacteria Counts (TBC's) from a deep well water source

Because of the poor bacteriological quality of the water, it was decided to disinfect the water using CREDENCE, with a proportional dosing system, (see section 6.0 for more details). A "Dosatron" proportioner was used to continually achieve a dosage of 5mg/l available chlorine from a stock solution of 2000mg/l available chlorine (set at 0.25%). The water quality was evaluated as follows:

Table 10

	Target	Before Treatment	After Treatment
TVC @ 37°C (cfu/ml)	<200 (>10,000 = poor)	11,000	500
Coliforms (per 100ml)	0	20	0

A batch of pigs was followed from weaning to slaughter, the pigs and the water proportioning system being moved in tandem through the unit. Water samples were taken at the drinkers and tested using residual chlorine test strips. The residual chlorine levels indicated a stable end concentration of 5mg/l available chlorine.

Individual batches of pigs were blood sampled or meat juice sampled, and categorised in accordance with the Danish mix ELISA test. Batches with minimal *Salmonella* antibodies (<10% positive) were given a Category 1 status, those with between 10% and 50% positives were given Category 2 status, whilst those with antibody levels greater than 50% were placed in Category 3. This categorisation is utilised in Danish and Irish *Salmonella* control programmes. Pigs that travelled through the unit before the experimental period acted as positive controls, whilst those travelling through the unit after completion of the experimental period reflected any residual effect of the disinfection of the water system.

The results are given in table 11:

Table 11

Historic Blood and Meat Juice *Salmonella* ELISA Results for the Herd

Date	No. Samples	No. Positive	No. Negative	% Positive	Category
5/03/98	30 meat juice	3	27	10	2
28/09/98	30 meat juice	29	1	97	3
13/04/99	30 meat juice	30	0	100	3
19/10/99	10 serum	5	5	50	3
13/01/00	10 serum	5	5	50	3
28/03/00	30 meat juice	27	3	90	3
5/05/00	24 meat juice	23	1	97	3

All samples were taken from slaughter-weight pigs, either at the slaughterhouse (meat juice) or on the farm prior to dispatching to the slaughterhouse (serum).

Three batches of pigs were sampled prior to the commencement of the trial (table 12). These samples were taken from the pigs at different stages. The first batch was taken in the second-stage weaner house - 20% of these pigs were positive for *Salmonella* antibodies. Three weeks later this level had increased to 47%, and further to 97% by the time of slaughter. These data show that the pigs were sero-converting somewhere between the second-stage and the fattening houses - indicating possible exposure 2-3 weeks previously, in the second-stage weaner house.

Table 12

Assessment of the Extent of *Salmonella* Antibodies Prior to Disinfection

Date	No. Samples	No. Positive	No. Negative	% Positive	Category
10/07/00 Positive Controls	30 second-stage weaners	6	24	20	2
10/07/00 Positive Controls	30 early finishers	14	16	47	2
10/07/00 Positive Controls	30 mid-finishers	29	1	97	3

Blood samples were taken from the pigs during the trial (table 13). There was a significant reduction in the levels of antibodies detected - 13% now showing positive levels. Blood samples taken from the slaughtered pigs at the end of the trial continued to show this trend towards Category 1 and 2 status. Incidence of antibody response was down to 25% from 97%.
Since the end of the trial period the *Salmonella* Categories 1 and 2 have been maintained.

Table 13

***Salmonella* ELISA Test Results, During and After the Trial Period**

Date	No. and Type of Samples	No. Positive	No. Negative	% Positive	Category
8/08/00	30 serum, at random during trial	4	26	13	2
15/09/00	10 serum, finishers	2	8	20	2
20/09/00	17 serum, gilts	2	15	12	2
16/10/00	197 serum, slaughter	52	145	26	2
30/11/00	20 serum, finishers	2	18	10	1
19/02/01	25 serum, finishers	5	20	20	2

At the start of the study, the farm was using a liquid, concentrated peroxygen compound for environmental disinfection (surfaces). Practical problems were encountered, because correct dilutions were not being observed. The product was found to be irritant and corrosive, and there were handling problems associated with manipulating 200 litre barrels. CREDENCE (see section 7.0) was chosen to replace the existing product because it was found to be more user-friendly. This enabled a practical farm-wide programme for routine and terminal disinfection, using an in-use dosage of 500mg/l available chlorine.

The study concluded:

- *Total bacterial counts achieved at the end of the pipeline fell during the course of the programme. This was due to more attention being paid to waterlines on the farm, coupled with the application of the water chlorination system.*
- *Salmonella ELISA scores for the pigs passing through the unit also fell during the course of the experiment, as a direct effect of water chlorination, coupled with a better washing and disinfection programme.*
- *There was a significant management input into the entire programme. The effects of this cannot be discounted, as there has to be farmer co-operation and commitment if any programme is to be implemented.*
- *There was an increased job satisfaction among the staff because the washing being done was seen to be contributing to the overall health of the pigs on the unit.*
- *Meat quality was also improved with the absence of Salmonella contact, ultimately contributing to food safety.*
- *CREDENCE is easy to use because of their convenient presentation.*

5.4 Rabbit Trial

5.4.1 Study on a Rabbit Farm - Water Quality (22)

Whilst the water quality of the mains supply to the rabbit farm was of potable quality, the water quality being consumed by the rabbits was contaminated due to pollution in the water distribution system on the farm.
The farm held 350 female rabbits, which were managed in groups, with the use of artificial insemination every 6 weeks. The buildings consisted of a nursery room and a fattening room. The fattening room used three rows of cages, with 316 rabbits per row. A water tank, with an 80 litre capacity, was installed at the end of each row.
One row was treated with CREDENCE to achieve a residual "free" chlorine level of 0.5mg/l at the end of the drinking water line - this was measured using the DPD method. When the residual chlorine level dropped below 0.5mg/l a further CREDENCE tablet was added to the tank. Water samples were taken at the end of the water line at the start of the trial and at the end of the trail, both for the treated row and also for an untreated row. Table 14 gives the analysis results:

Table 14

Microorganisms	Standard Row (Not Treated)		Treated Row	
	Start	End	Start	End
Total Coliforms at 37°C/100ml	0	24	0	0
Thermoresistant Coliforms at 44 °C/100ml	0	20	0	0
Enterococcus/100ml	0	5	0	0
Innocuous Microorganisms at 37°C/ml	0	50	0	0
Innocuous Microorganisms at 22°C/ml	10	>3000	7	7
Sulphite reducing *Clostridium* at 37°C/20ml	0	0	0	0

To maintain a satisfactory level of disinfection, the farmer added 1 CREDENCE tablet to the tank every 2 days at the start of the fattening. At the end of the fattening period, owing to increased water consumption, he added 1 tablet per day. In total, 20 CREDENCE tablets were used for an estimated water consumption of $30m^3$, for 316 rabbits, over 35 days of fattening - an average dose of 1 tablet per 150litres consumed.

The conclusions from the trail were:

- *The two analyses carried out at the start of the trial showed that the public water supply, used by the rabbits, is fit for drinking*
- *At the end of the 35 day fattening period of the trial*
  - *the water in the untreated row is polluted*
  - *CREDENCE prevented bacterial proliferation in the treated row*
- *Despite the use of public mains water supply, the trial shows that there is a rapid development of bacteria in the water pipes on the farm*
- *Disinfection of water, using CREDENCE, is necessary to guarantee the potability of water consumed by rabbits, even when the water supplied to the farm is of good quality*

5.5 Dairy Trial

5.5.1 Study on a Dairy Farm - Elimination of *Listeria* (23)

The trail was set up to evaluate the bactericidal efficacy of CREDENCE against *Listeria monocytogenes* in drinking water on dairy farms.
Three dairy farms were chosen due to contamination of the tank milk by *Listeria monocytogenes*, which had already been isolated from the water supplies. Water samples were taken at the drinking water troughs before and after treatment with CREDENCE. Treatment was by the addition of CREDENCE directly to the troughs to achieve a dosage of 5mg/l "free" chlorine. The residual available chlorine level was measured 20 minutes after adding the tablets. The water was re-sampled and analysed 6 hours later for *Listeria.*
Listeria was isolated from one of the three farms. The addition of CREDENCE at 5mg/l available chlorine eliminated the *Listeria*, leaving a residual chlorine level of 3.5mg/l after 20 minutes.
The study concluded:

- *CREDENCE is effective in destroying Listeria monocytogenes at the recommended dosages*
- *The addition of CREDENCE directly into the continuous flow tanks, or into static flow tanks, is difficult to control on the farm. The use of a metering pump* (proportional injector - see section 6.0) *to inject CREDENCE into the water distribution system is more practical.*

5.6 Conclusions

Many published studies (e.g. refs. 24, 25, 26, 27, 28) validate and recommend the chlorination of poultry drinking water. Benefits in terms of better water quality, improved weight gains, feed conversions and mortalities, drier litter, lower ammonia levels etc. are all demonstrated.
A wide range of independent studies clearly demonstrate the benefit of CREDENCE in rendering poor quality waters safe to drink, with subsequent benefits in terms of improved farm productivity, improved biosecurity and better quality produce. Furthermore, trials comprehensively validate the superior activity of CREDENCE when compared to alternative chlorine donors including hypochlorites, halazone and chloramine, (full details of the chemistry and comparison with other chlorine donors are included in the report "Chemistry of Sodium Dichloroisocyanurate: Water Disinfection"

It should also be noted that, unlike other chlorine donors which are alkaline, CREDENCE is acidic and will marginally reduce the pH of water. Water of a slightly acidic nature is believed to be beneficial to the gut condition of livestock. It is believed that lowering the pH in the digestive tract decreases the ability of pathogens to grow, and activates stomach enzymes to promote more efficient feed conversion. Trail work involving broilers revealed that acidification had the effect of improving gut microflora and decreasing incidence of *Salmonella* and other harmful enteric infections. The swine water study Case Report (21) presumed that the management and production changes, allied to their use of CREDENCE, had positive effects on the environment of the pigs and a positive effect on the gut microflora, either directly or indirectly. This double activity of CREDENCE, as an effective biocide and acidifying agent, may help explain the significant productive effects (better weight gain, improved feed conversion etc.) consistently found with the use of CREDENCE.

Furthermore, the restrictions and bans on the use of antibiotic growth promoters make the findings from these studies even more significant. It is clear that antibiotic promoters improve performance, partially through protection from environmental challenges, as well as through nutrient digestibility enhancement. As the use of such products is reduced, greater emphasis will have to be placed on preventive measures to reduce the biological challenges to livestock.

CREDENCE is not only demonstrably effective but is also safe and easy to handle. Accurate dosages are achieved without the need to spend time measuring out or weighing liquids or powders.

The safety and effectiveness of CREDENCE for water disinfection is assured, but how is it applied?

6.0 DOSING OF CREDENCE FOR SAFE DRINKING WATER

Being in tablet format means that CREDENCE is easier to handle than liquids or powders. It is also easier to calculate the correct dosage because one tablet will treat a fixed volume of water (see Appendix 7). With liquids or powders the strength first needs to be evaluated and then the correct weight or volume measured, before being mixed with water. Water should be continuously disinfected, either by hand dosing directly into the storage or header tanks, or by using (semi) auto-dosing systems. Kiotechagil proposes three auto-dosing options:

a) A low technology constant-head drip feeder

b) Proportional liquid dispensers.

c) The CREDENCE Select Dosing System

Whichever system chosen, the water should be dosed to a sufficient level to achieve a residual "free chlorine" level of about 0.5 mgs/litre (ppm) at the last drinking water point in the line. The "free chlorine" level can be measured very simply by using "Free Chlorine" test strips.

Where the "free chlorine" cannot be measured, then a dosage of 1.5 to 3 mgs/litre (ppm) has been shown to be effective in clear water, and 4 to 6 mgs/litre (ppm) in dirty water. This will keep the water disinfected, and help to prevent the build-up of biofilms and algae. The entire water system should always be kept under positive pressure, with the pipework always full of disinfected water.
When administering medicaments, (vaccines/antibiotics etc.), in the drinking water, the CREDENCE should be neutralised. In conjunction with the medicaments, 2.5g of skimmed milk (powder) per litre is recommended to be added to the water at a point in the system after it has been disinfected. The milk neutralises the CREDENCE and also colours the water, showing when the medicated water comes on-line and off-line.

Routinely, the entire water system should be drained. Where there is algae growth and biofilm accumulation, this should be physically removed from the tanks and the pipework flushed with an acid cleaner (e.g. vinegar). The entire system should then be flushed out to remove debris. CREDENCE should be added to the header tank at a dosage of 25mg/l chlorine, and the entire system filled with the solution, and allowed to stand for 30 mins. The system is then drained and refilled with fresh water. If the water source/well becomes organically contaminated, or if a new well is constructed, the well and system must be disinfected. Procedures for well and system disinfection using CREDENCE are given in Appendix 6. It should be noted that CREDENCE is compatible with dosing equipment; it does not leave deposits in pipelines or blockages in drinker nipples etc. In fact, it keeps the whole system clean and disinfected when properly administered. (CREDENCE is not corrosive.

7.0 THE ELIMINATION OF PATHOGENIC MICROORGANISMS IN THE ENVIRONMENT USING CREDENCE

Good animal husbandry necessitates the identification of critical control points (CCP's) in the farm environment where pathogenic organisms need to be controlled, to safeguard the health of stock, staff and ultimately consumers. Once identified, the principal means of control will be through implementation of a disinfection programme. Such a programme needs to use wide-spectrum disinfectants that have been validated effective, and be practical and easy to understand.

Medentech has addressed the validation of CREDENCE by:

i) Carrying out a series of *in vitro* tests on a wide range of microorganisms of significance in farming environments.
ii) Supporting these tests with *in vivo* studies on the farm at critical control points, in a wide variety of circumstances.

Using these validations, comprehensive disinfection programmes have been produced. (Refer to Appendix 3 for poultry and 4 for swine.)

CREDENCE utilises the active sodium troclosene (NaDCC) in a uniquely formulated effervescent tablet. Due to its specific chemistry, sodium troclosene has been shown to be an extremely effective and wide-spectrum biocide. It is a chlorine donor, but is far more active than hypochlorites or other chlorine products.

7.1 *In Vitro* Tests

Table 9 that follows summarises *in vitro* test results undertaken to date relative to the farming environment:
[Note: 1ppm = 1mg/l available chlorine]

BACTERIA **Table 9**

Organism	Surface Test	Suspension Test	Organic Challenge	Conc (Av Cl)	Test Standard	Disease/Effect	Ref
Actinobacillus pleuropneumonia	✔	X	X	325ppm	BESU (MIC)	Actinobacillosis	29
Aerobacter (Enterobacter) aerogenes	✔	X	X	200ppm	AOAC	Cystitis etc	30
Aeromonas hydrophila	X	✔	0.03% Bovine Albumin	100ppm	EN 1276:1997	Enteritis etc	31
Bacillus anthracis *	X	✔	5% yeast	900ppm	UK MAFF	Anthrax	32
Bacillus intestalis	✔	X	X	200ppm	GOST 739-68, 1119-73	Enteritis etc	33
Bordetella bronchiseptica	X	✔	X	200ppm	BS 3286; 1960	Rhinitis, distemper etc	34
Bordetella bronchiseptica	X	✔	2.5% yeast	200ppm	BS 3286; 1960	Rhinitis, distemper etc	34
Brachispira (Serpulina/Treponema) hyodysenteriae (10 strains)	X	✔	X	<10ppm	Edinburgh University	Swine Dysentery	35
Brucella sp*	X	✔	5% yeast	900ppm	UK MAFF	Brucellosis	32
Campylobacter jejuni	X	✔	0.03% Bovine Albumin	100ppm	EN 1276: 1997 (mod)	Enteritis	36
Enterobacter cloacae	X	✔	0.03% Bovine Albumin	100ppm	EN 1276: 1997 (mod)	Entero infections	36
Enterococcus faecium (CNCM5855*)*	X	✔	X	100ppm	AFNOR NFT 72.151	Enteritis etc	37
Enterococcus faecium (CIP5855)	X	✔	Milk	160ppm	AFNOR NFT 72.170	Enteritis etc	38
Enterococcus faecium (CIP5855*)*	✔	X	X	100ppm	AFNOR NFT 72.190	Enteritis etc	39
Enterococcus hirae (CIP5855)	X	✔	X	50ppm	AFNOR NFT 72.301	Enteritis etc	40
Erysipelotrix rhusopathiae	X	✔	X	200ppm	BS 3286:1960	Erispelas	34
Erysipelotrix rhusopathiae	X	✔	2.5% yeast	200ppm	BS 3286:1960	Erispelas	34

Organism	Surface Test	Suspension Test	Organic Challenge	Conc (Av Cl)	Test Standard	Disease/Effect	Ref
Escherichia coli (CIP 54 127)	X	✔	X	50ppm	AFNOR NFT 72.301	Enteritis, scour etc	40
Escherichia coli	X	✔	Milk	160ppm	AFNOR NFT 72.170	Enteritis, scour etc	38
Escherichia coli (CIP 54 127)	✔	X	X	100ppm	AFNOR NFT 72.190	Enteritis, scour etc	41
Klebsiella pneumoniae	X	✔	X	15ppm	Sao Paulo Univ	Pneumonia	42
Klebsiella pneumoniae (ATCC 4352)	X	✔	20% human serum	140ppm	Bologna Univ	Pneumonia	43
Leptospira interrogans ser.Icterohaemorrhagiae	X	✔	X	325ppm	BESU (MIC)	Leptospirosis	44
Listeria monocytogenes	X	✔	0.03% Bovine Albumin	100ppm	EN 1276:1997 (mod)	Listeriosis	36
*Mycoplasma sp**	X	✔	5% yeast	900ppm	UK MAFF	Mycoplasmosis	32
Pasturella multicoda	X	✔	X	200ppm	BS 3286:1960	Septicaemia, fowl cholera etc	34
Pasturella multicoda	X	✔	2.5% yeast	200ppm	BS 3286:1960	Septicaemia, fowl cholera etc	34
Plesiomonas shigelloides	X	✔	0.03% Bovine Albumin	100ppm	EN 1276:1997	Septicaemia	31
Proteus vulgaris	X	✔	X	15ppm	Sao Paulo Univ	Enteritis etc	42
Proteus vulgaris ATCC 881	X	✔	20% human serum	140ppm	Bologna Univ	Enteritis etc	43
Pseudomonas aeruginosa (CIP A22)	X	✔	X	50ppm	AFNOR NFT 72.301	Septicaemia etc	40
Pseudomonas aeruginosa	X	✔	Milk	160ppm	AFNOR NFT 72.170	Septicaemia etc	38
Pseudomonas aeruginosa (CIP A22)	✔	X	X	100ppm	AFNOR NFT 72.190	Septicaemia etc	41
*Pseudomonas malleri**	X	✔	5% yeast	900ppm	UK MAFF	Glanders	32

Salmonella choleraesuis (NCTC 10653)	X	✔	5% yeast	900ppm	UK MAFF	Salmonellosis etc	32
Salmonella faecalis (ATCC 10541)	X	✔	X	140ppm	Bologna Univ	Salmonellosis etc	43
Organism	**Surface Test**	**Suspension Test**	**Organic Challenge**	**Conc (Av Cl)**	**Test Standard**	**Disease/Effect**	**Ref**
Salmonella faecalis (ATCC 10541)	X	✔	20% human serum	140ppm	Bologna Univ	Salmonellosis etc	43
Shigella sp	X	✔	X	15ppm	Sao Paulo Univ	Shigellosis etc	41
Staphylococcus aureus (CIP 53 154)	X	✔	X	50ppm	AFNOR NFT 72.301	Wound infections etc	40
Staphylococcus aureus	X	✔	Milk	160ppm	AFNOR NFT 72.170	Wound infections etc	38
Staphylococcus aureus (CIP 53 154)	✔	X	X	100ppm	AFNOR NFT 72.190	Wound infections etc	41
Streptococcus dysgalactiae (NCTC 4335)	X	✔	X	150ppm	MIC Test	Fever, septicaemia etc	45
Yersinia enterocoltica	X	✔	0.03% Bovine Albumin	100ppm	EN 1276:1997	Yersiniosis	31

Note: included in General Orders test pass (MAFF)

MYCOBACTERIA

Organism	Surface Test	Suspension Test	Organic Challenge	Conc (Av Cl)	Test Standard	Disease/Effect	Ref
Mycobacterium smegmatis (CNCM 7326)	X	✔	X	100ppm	AFNOR NFT 72.151	Mycobacterial infections	37
Mycobacterium smegmatis (CNCM 7326)	X	✔	Milk	160ppm	AFNOR NFT 72.170	Mycobacterial infections	38
Mycobacterium smegmatis (CIP 7326)	✔	X	X	800ppm	AFNOR NFT 72.190	Mycobacterial infections	46

FUNGI

Organism	Surface Test	Suspension Test	Organic Challenge	Conc (Av Cl)	Test Standard	Disease/Effect	Ref
Aspergillus versicolor var niger (IP 1187 79)	X	✔	X	50ppm	AFNOR NFT 72.301	Aspergillosis	47
Candida albicans (CIP 1180 79)	X	✔	X	50ppm	AFNOR NFT 72.201	Candidiasis, scour	48
Scopulariopsis brevicaulis (IP 210 53)	X	✔	X	100ppm	AFNOR NFT 72.301	Ulcers, onchomycosis	47

SPORES

Organism	Surface Test	Suspension Test	Organic Challenge	Conc (Av Cl)	Test Standard	Disease/Effect	Ref
Bacillus arothermophylus	X	✔	X	140ppm	Bologna Univ	Food poisoning	43
Bacillus arothermophylus	X	✔	20% serum	140ppm	Bologna Univ	Food poisoning	43
Bacillus cereus	X	✔	0.03% Bovine	50ppm	EN 1276: 1997	Food poisoning	31

			Albumin				
Bacillus globigii	X	✔	X	140ppm	Bologna Univ	Food poisoning	43
Bacillus globigii	X	✔	X	140ppm	Bologna Univ	Food poisoning	43
Clostridium perfringenes	X	✔	0.03% Bovine Albumin	100ppm	EN 1276:1997	Food poisoning, Necrosis, sudden death	31
Clostridium perfringenes USDA	X	✔	X	140ppm	Bologna Univ	Food poisoning, Necrosis, sudden death	43
Clostridium perfringenes USDA	X	✔	20% serum	140ppm	Bologna Univ	Food poisoning, Necrosis, sudden death	43
Clostridium perfringenes USDA	✔	X	X	140ppm	Bologna univ	Food poisoning, Necrosis, sudden death	43
Clostridium tetani	X	✔	X	140ppm	Bologna Univ	Tetanus	43
Clostridium tetani	X	✔	0% serum	140ppm	Bologna Univ	Tetanus	43

VIRUSES

Organism	Surface Test	Suspension Test	Organic Challenge	Conc (Av Cl)	Test Standard	Disease/Effect	Ref
ADENOVIRUS							
Adenovirus	X	✔	X	131ppm	AFNOR NFT 72.180	Adenovirus infections etc	49
Infectious canine hepatitis	X	✔	X	100ppm	AFNOR NFT 72.180	Hepatitis	50
APHTHOVIURS (PICORNAVIRUS)							
Foot and mouth disease	X	✔	5% ox serum	1000ppm	UK MAFF	Foot and mouth disease	32
BACTERIOPHAGE							
T2 & E coli B	X	✔	X	120ppm	AFNOR NFT 72.181		51
MS2 & E coli HFrh	X	✔	X	40ppm	AFNOR NFT 72.181		51
X174 & E coli ATCC13706	X	✔	X	50ppm	AFNOR NFT 72.181		51

Lactic no 66 & streptococcus lactis diacetylactis	X	✔	X	200ppm	AFNOR NFT 72.181		51
BUNYAVIRUS							
Gumboro disease IBDV DV86	X	✔	0.03% Bovine Albumin	500ppm	UK MAFF	Infectious Bursal Disease	52
CORONAVIRUS	✔	✔					
Trans Gastroenteritis (Pigs)	X	✔	0.03% Bovine Albumin	333ppm	UK MAFF	TGE	52
ENTEROVIRUS (PICORNAVIRUS)							
Swine Vesicular disease	X	✔	X	500ppm	UK MAFF	SVD	32
Talfan	X	✔	X	100ppm	AFNOR NFT 72.180	Talfan Disease	50
HERPESVIRUS							
Aujeszkey's disease (pigs)	X	✔	0.03% Bovine Albumin	333ppm	UK MAFF	Aujeszkey's disease	52

Organism	Surface Test	Suspension Test	Organic Challenge	Conc (Av Cl)	Test Standard	Disease/Effect	Ref
Marek's disease (poultry)	X	✔	0.03% Bovine Albumin	1000ppm	UK MAFF	Marek's disease	52
IRIDOVIRUS							
Africanswine fever	X	✔	0.03% Bovine Albumin	333ppm	UK MAFF	Swine Fever	52
ORTHOMYXOVIRUS							
Avian influenza	X	✔	0.03% Bovine Albumin	333ppm	UK MAFF	Fowl plague	52
PARAMYXOVIRUS							
Newcastle disease (Herts 33/56)	X	✔	5% yeast	700ppm	UK MAFF	Newcastle disease	32
PARVOVIRUS							
Porcine parvovirus	X	✔	0.03% Bovine Albumin	333ppm	UK MAFF	Parvovirus disease	52
PESTIVIRUS(TOGAVIRUS)							
Hog cholera	X	✔	0.03% Bovine Albumin	333ppm	UK MAFF	Hog Chlorera, CSF	52
POXVIRUS							
Avipox (fowl pox)	X	✔	0.03% Bovine Albumin	333ppm	UK MAFF	Fowl pox	52
REOVIRUS							
Runting/stunting (poultry)	X	✔	0.03% Bovine Albumin	333ppm	UK MAFF	Tenosynovitis	52
RHABDOVIRUS							
Rabies (Canine RV CBS)	X	✔	0.03% Bovine Albumin	333ppm	UK MAFF	Rabies	52

7.2 *In Vivo* Trials

Studies have been undertaken to validate the effectiveness of CREDENCE on:

- hard surfaces - floors and walls
- feeding equipment - feed/water troughs and bottles/teats
- pipelines and equipment.

7.2.1 Hard Surface Disinfection

Several trials on disinfection of floors and walls have been undertaken:

a) Floors and Walls of Pig Pens (53)

Fattening houses consisting of 6 similar pens each normally housing 15 pigs were chosen. Walls were a smooth plaster finish and floors were slatted. All pens were emptied at the same time, and then washed with water only.

Swabs were taken from floors and walls in each pen. Each pen was then sprayed with a CREDENCE solution, using a knapsack sprayer. Swabs were then taken from the corresponding floor and wall surfaces. Three sampling periods were chosen.

The results are given in Table 10 overleaf:

Total viable counts were reduced on average, by over 98%. In general, coliform and *E. coli* counts were low, because this unit is a minimal disease unit (with no *Salmonella*). Where pens had higher counts they were significantly reduced.

Table 10:

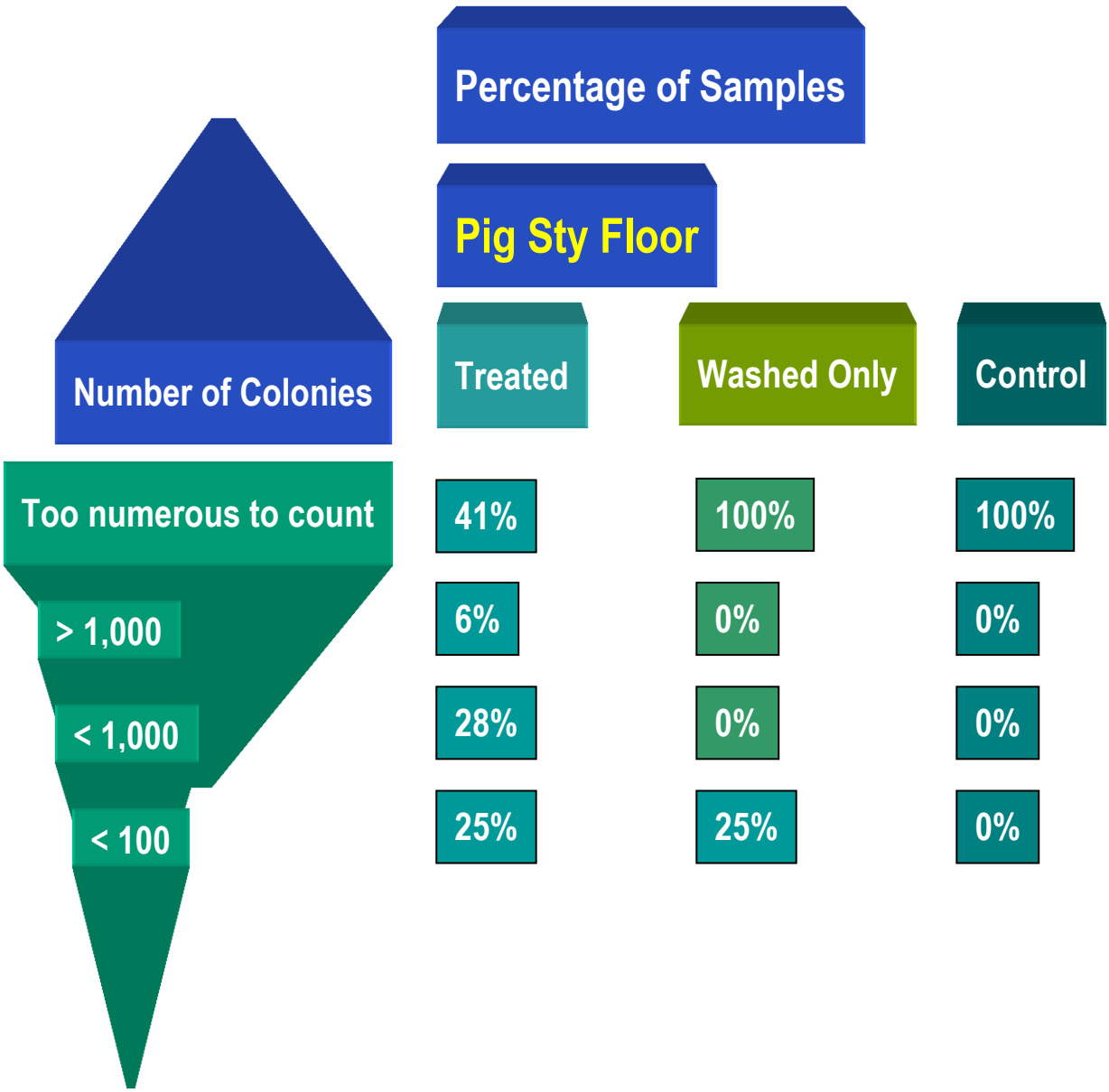
CREDENCE Dosage: 500ppm Available Chlorine

Sample	Location	CFU/ml								
		Total Viable Count			Coliform Count			*E coli*		
		Control	Treated	% Reduction	Control	Treated	% Reduction	Control	Treated	% Reduction
25.01.99	Wall A	1.4×10^4	5.9×10^3	57.86	<3	<3	-	<3	<3	-
	Wall B	5.1×10^4	9.9×10^2	98.06	<3	<3	-	<3	<3	-
	Floor A	$>3 \times 10^6$	2.9×10^4	>99.03	$>1.1 \times 10^3$	4	>99.64	15	<3	>80.00
	Floor B	$>3 \times 10^6$	2.4×10^4	>99.20	$>1.10 \times 10^3$	<3	>99.73	20	<3	85.00
02.02.99	Wall A	$>3 \times 10^7$	$3.6x\ 10^4$	>99.88	$>1.1 \times 10^3$	9	>99.18	90	<3	>96.67
	Wall B	$>3 \times 10^7$	$>3.0 \times 10^5$	>99.00	$>1.1 \times 10^3$	2×10^2	>81.82	1.5×10^2	9	94.00
	Floor A	$>3 \times 10^7$	$>3.0 \times 10^5$	>99.00	$>1.1 \times 10^3$	5×10^2	>54.54	2.1×10^2	<3	98.50
	Floor B	$>3 \times 10^7$	$> 3.0 \times 10^5$	>99.00	$>1.1 \times 10^3$	$>1.1 \times 10^3$		2×10^2	2×10^2	-
09.02.99	Wall A	$>7 \times 10^6$	1.5×10^5	97.86	$>1.1 \times 10^3$	90	>91.82	<3	<3	-
	Wall B	1.3×10^6	5.1×10^5	49.38	90	40	55.55	4	40	-
	Floor A	2.3×10^7	1.2×10^6	94.78	$>1.1 \times 10^3$	2×10^2	>81.28	11	<3	>72.73
	Floor B	1.8×10^8	$>3 \times 10^6$	<98.33	$>1.1 \times 10^3$	1.1×10^3	-	90	20	77.77

b) Pig Sty Floor (54)

The study was carried out in a masonry sty that housed 4 pigs. Initially the floor was washed in the normal way. Swabs were taken in two corners twice a week for 15 days.
In the following weeks (30 days) CREDENCE, at a dosage of 350mg/l available chlorine, was applied. Swabs were taken from the corresponding corners 30 minutes after disinfection.
Twenty days after the last application of CREDENCE, new swabs were taken to act as control.
Table 11 summarises the results:

Table 11



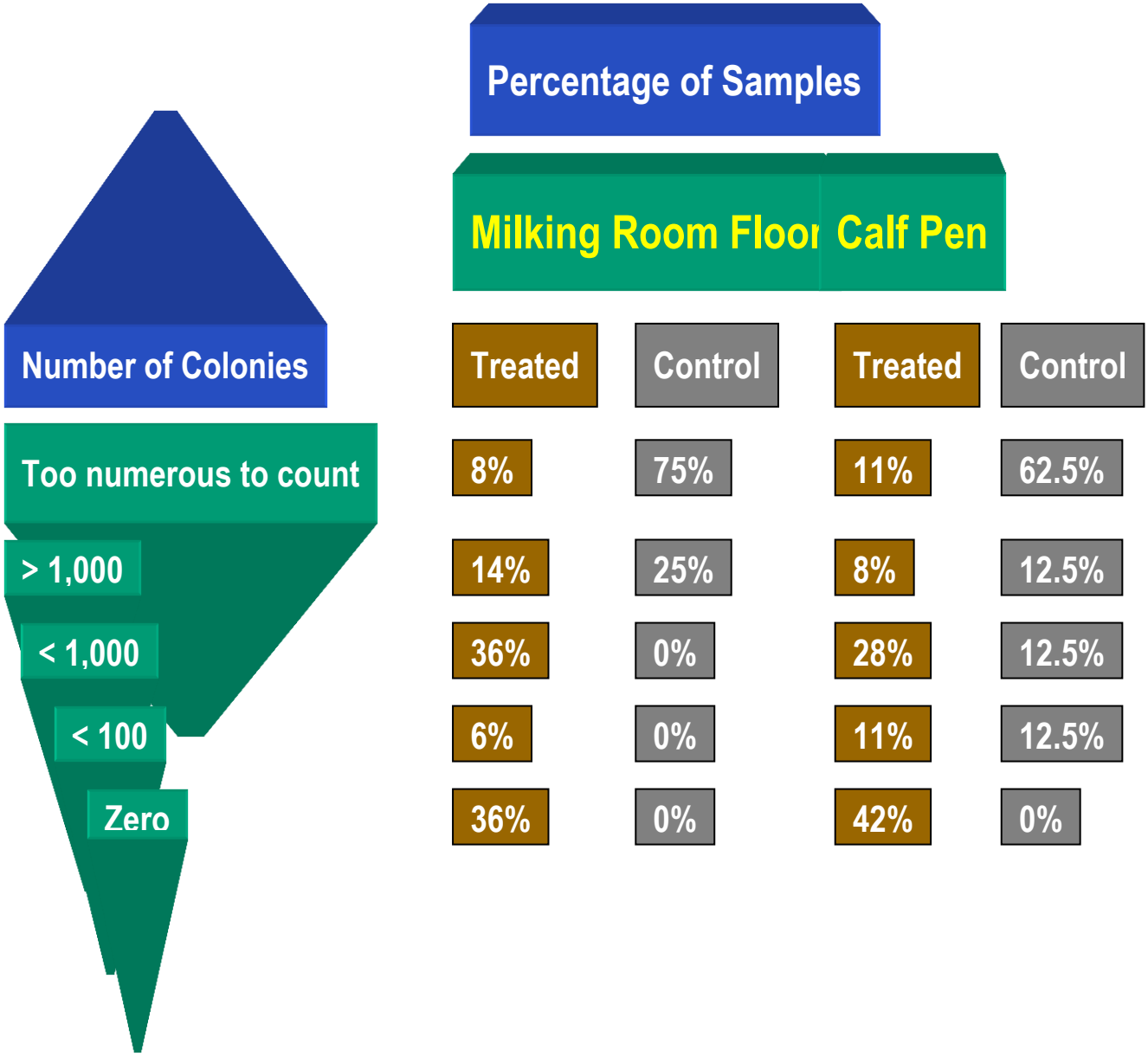
There was a significant quantitative reduction in the numbers of microorganisms involved, when CREDENCE was used.

c) Floors of Milking Room and Calf Pen (54)

The action of CREDENCE was studied on the hygiene of a milking room and calf pen. Samples were taken from two previously determined corners of each environment, before and after treatment. Swabs were taken from the floors twice a week for 15 days, 30 minutes after using CREDENCE, at a dosage of 350mg/l available chlorine.

Table 12 summarises the results:

Table 12



There was a significant reduction in bacterial burden, with 36% and 42% negative samples in the milking room and calf pen respectively, which did not occur in the control period, (where 75% and 62.5%, respectively, were too numerous to count).

The Annals of the 23rd Brazilian Congress of Veterinary Medicine recorded that *"The use of the product revealed a quantitative reduction of the bacterial flora and no enterobacteriaceae, which are most times associated with neonatal enteritis, were isolated from the calf pens, suggesting the efficacy of the product on the environments studied."*

d) Poultry Housing (19)

The rooms and installations were disinfected before arrival of the experimental animals (600 Ross cocks). The experimental space (walls, floor) and cages, including feeders and drinkers were divided into two parts. In one part formalin disinfectant was applied and the second part was disinfected using CREDENCE at 500mg/l available chlorine strength, to compare the efficacies of the two disinfectants.

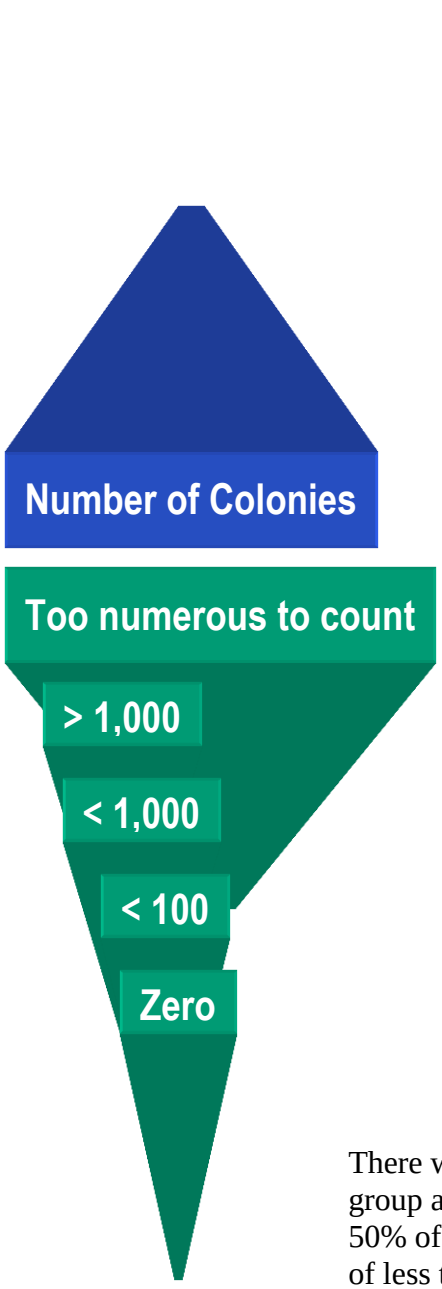
It was reported that *"the effect of disinfection with formalin and CREDENCE of animal rooms and cages were measured by a microbiological method (total count per 100cm^2), and determination of the presence of Salmonella. No difference could be detected in contamination or Salmonella prevalence between formalin and CREDENCE ^{disinfected} cages and environment."*

7.2.2. Feeding Equipment

a) Horse Feed Trough and Water Trough (54)
Two horse stalls were selected and the feed and water troughs washed in the customary way, without the use of CREDENCE, this period being the control. In the second week the troughs were disinfected daily using CREDENCE at a dosage of 350mg/l available chorine, over 3 weeks. Swabs were taken 30 minutes after treatment, throughout the whole lengths of the troughs. Collections were also realised 20 days after stopping the use of CREDENCE, as an additional control.

Table 13 summarises the results:

Table 13



Percentage of Samples						
Horses						
Feed Trough			Water Trough			
Treated	Wash only	Control	Treated	Wash only	Control	
14%	75%	100%	32%	100%	75%	
4%	25%	0%	0%	0%	25%	
9%	0%	0%	18%	0%	0%	
27%	0%	0%	36%	0%	0%	
46%	0%	0%	14%	0%	0%	

There was a significant quantitative difference between the CREDENCE treated group and both the wash only and control groups. Using CREDENCE, 73% and 50% of the samples, for the feed troughs and water troughs respectively, had counts of less than 100 colonies. In contrast, the feed troughs had 75% of the samples for the wash only group, and 100% of the samples for the control, too numerous to count. Corresponding figures for the water troughs were 100% and 75%.

b) Calf Feeding Bottle Teat (55)

The effects of a 5 second spray of a solution containing 1500mg/l available chlorine on the microbial condition of the teat of a calf feeding bottle was measured, with the following results:

Table 14

	No Colonies		
Treatment	**Tip of teat**	**Base of teat**	**Average**
None (control)	34.8	68.0	51.4
Water	66.0	32.0	49.0
CREDENCE	0.4	0.4	0.4

For each 5 second treatment there were 5 repetitions. Samples were taken 30 seconds after spraying. CREDENCE was very effective in the destruction of the bacteria.

7.2.3 Pipelines and Equipment (54)

As a routine, 70 litres of water was used to disinfect the pipelines of milking machines, using 3 washes:

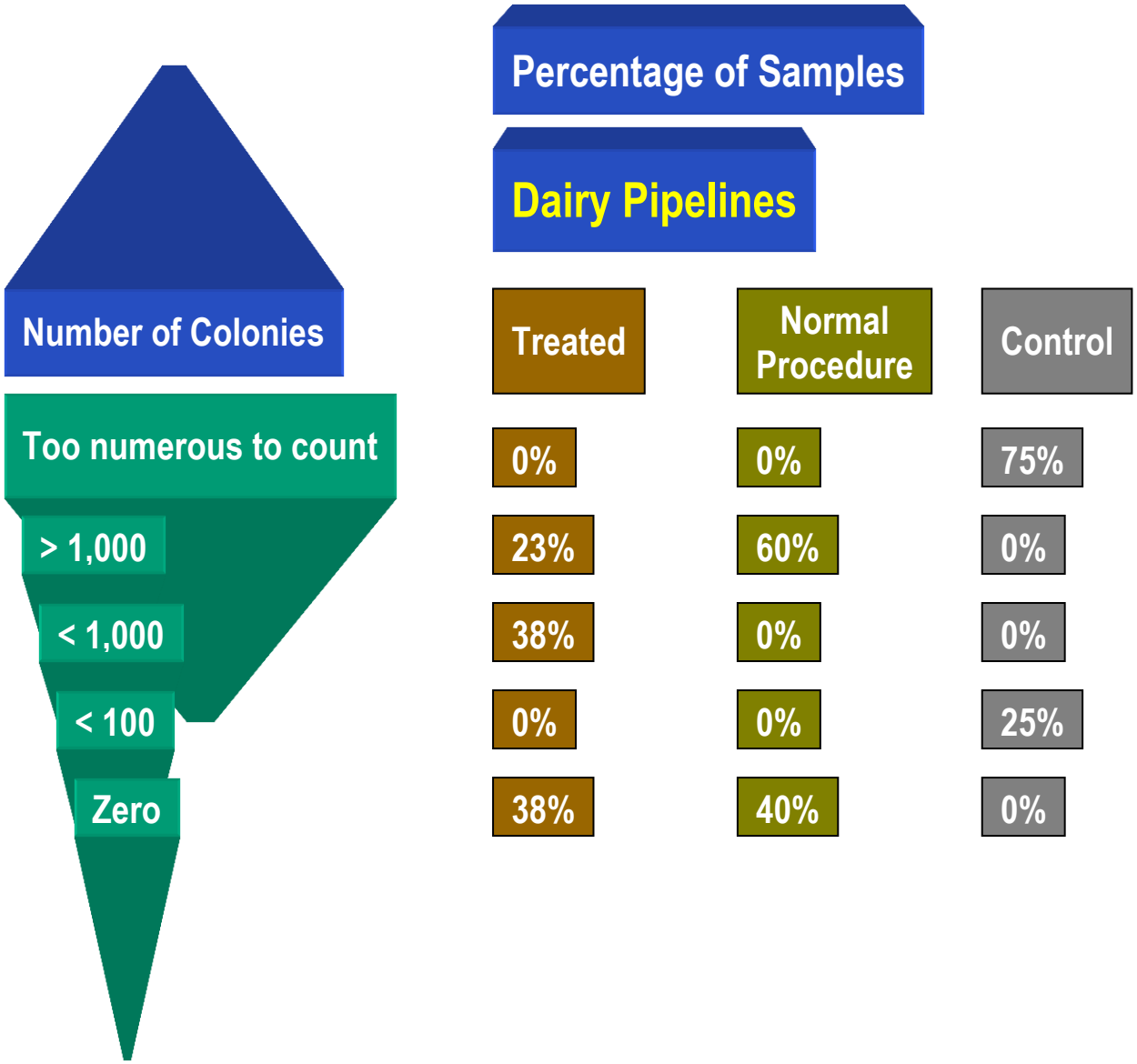
1) cold water only
2) hot water, detergent (Saniclean), hypochlorite and an acid cleaner (SaniAcid)
3) cold water rinse.

This procedure was used twice daily, after milking.

Samples were taken, without the use of CREDENCE, twice weekly for 15 days.
For the next 2 weeks CREDENCE was added to the cold water rinse (3rd stage) in doses between 10 and 28mg/l available chlorine. A further 13 samples were taken from inside the pipelines.
Twenty days after finishing the trial with CREDENCE, further samples were taken for control purposes.

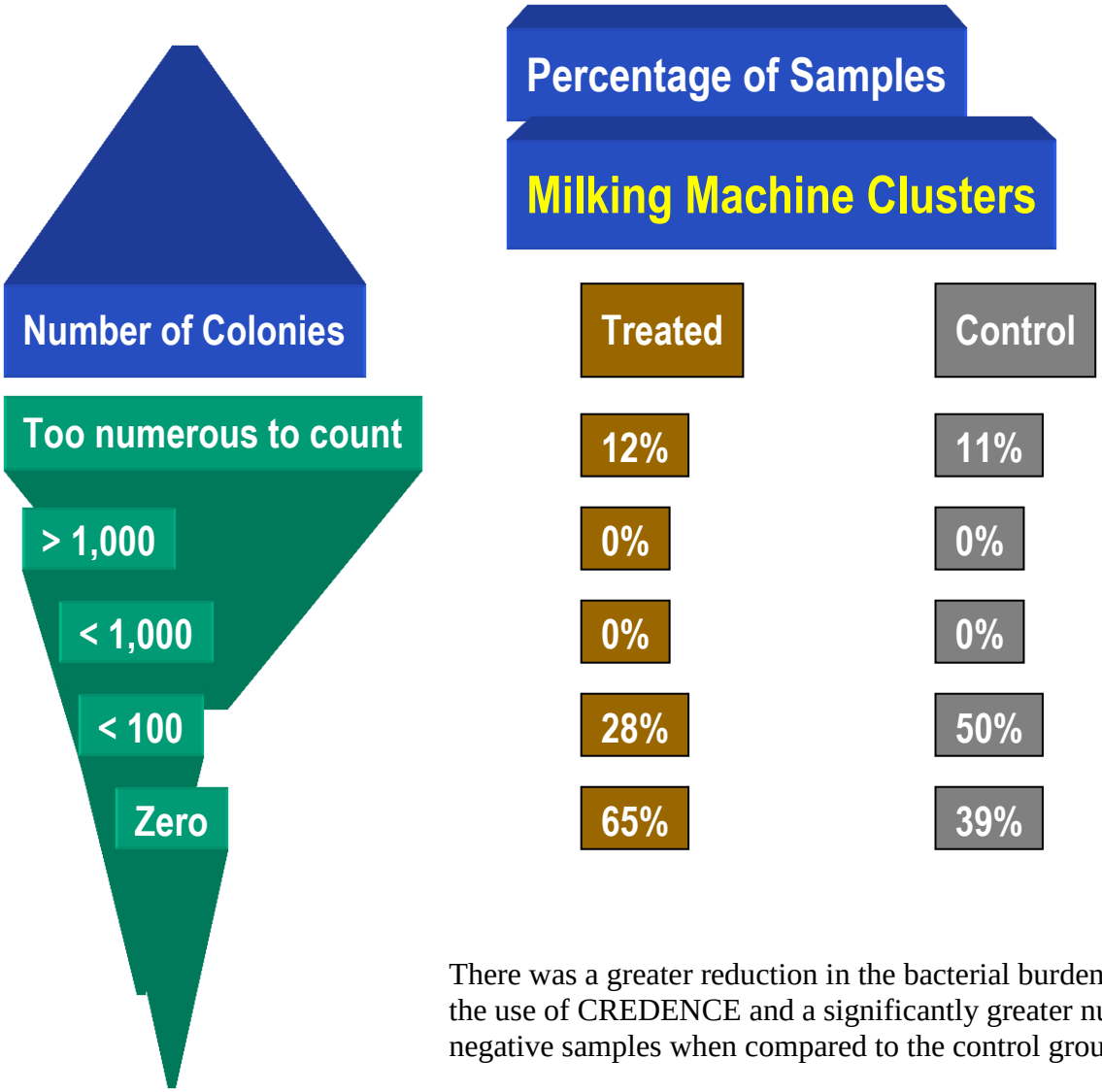
The results are included in Table 15:

Table 15



A further trial was undertaken to compare the disinfection activity of a commercial hypochlorite with CREDENCE on milking machine clusters (the milking cups). The disinfectant solutions were made up to 4 litres in a bucket. The milking clusters were dipped into the bucket for disinfection. Then samples were taken from the bucket for analysis. For CREDENCE the initial strength of solution was 1400mg/l available chlorine, which was used on 4 cows successively. All samples were negative. Subsequently a solution strength of 280mg/l available chlorine was used. Samples were collected after the cup was used on 2 cows successively. The total number of cows was ten, corresponding to 5 samples for each of 7 collections (Sample 5 was, therefore, after use on 10 cows successively).
Following this, the same procedure was used, but substituting CREDENCE with a commercial hypochlorite, as the control.
The results are given in Table 16:

Table16



There was a greater reduction in the bacterial burden with the use of CREDENCE and a significantly greater number of negative samples when compared to the control groups.

7.3 Conclusions

The *in vitro* studies comprehensively validate the effectiveness of CREDENCE against a wide range of pathogens of specific concern to a farmer, including bacteria, spores, fungi and viruses. Furthermore, these studies have been undertaken to internationally recognised protocols.

In support of this validation *in vivo* studies have also been undertaken to demonstrate that CREDENCE will control microbial hazards at identified Critical Control Points in the farming environment.

Additionally, CREDENCE is a practical and safe product. Achieving in-use dilutions is simply a matter of adding a tablet to a known volume of water. There is no need to use a variety of disinfectants that inevitably need measuring out and mixing into a solution. The CREDENCE disinfection programmes are simple to understand (ref. Appendices 3 & 4) and apply.

8.0 BENEFITS OF THE CREDENCE DISINFECTION PROGRAMMES

Today's intensive livestock production has led to remarkable increases in farm productivity. This intensity has realised great benefit to the farmer and consumer alike. But, if productivity levels and profits are to be maintained, it is essential for the farmer to implement good animal husbandry. Implementation of good farming practices will protect livestock and consumers from disease and other hazards, using HACCP system principles. Examples of good farming practices are given in Appendix 2. These require protection from biological hazards, which in turn require disinfection programmes.

The validated CREDENCE programmes are designed for practical application, benefiting the farmer, and subsequently the consumer, in terms of healthy livestock, safe produce, increased productivity - leading to increased profit.

CREDENCE has the following advantages for the farmer:

- They have a demonstrable rapid and broad spectrum of activity. This activity has been independently verified in field and laboratory trials.
- The product is conveniently available in the form of safe, rapidly soluble effervescent tablets for simple disinfection of farm water, surfaces and equipment.
- By incorporation into a biosecurity control programme, they will help to prevent livestock infections and reduce food safety issues in compliance with HACCP system requirements.
- The CREDENCE range is easy and safe to transport and to handle (does not spill or leak) and takes up far less storage space than liquid products.
- In-use dilutions are easily understood and achieved.
- Unlike many other disinfectants, and particularly chlorine products, CREDENCE has great stability: 3 years in unopened tubs.
- Cost of in-use dilutions is easily evaluated and is inexpensive. In addition, there are further cost benefits due to reduced waste (liquids can be overdosed, whereas dosing with tablets is exact) and reduced staff time (in measuring out liquids, or evaluating dosage requirements and dilutions).
- They have consistent quality and reliable strengths. Liquids are produced to various strengths and compositions (e.g. bleaches, hypochlorites, are available from 1%, 2%, 5%, 5.25%, 0%, 12% this inconsistency is difficult to incorporate in an effective infection control programme).
- The derivatives of the active ingredient of CREDENCE (isocyanurate) are relatively non-toxic and are biodegradable in the environment.

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APPENDIX 1

THE PRINCIPLE HACCP ACTIVITIES

Introduction

This appendix presents a brief introduction to the HACCP system and is taken from "Training Considerations for the Application of Hazard Analysis Critical Control Point System to Food Processing and Manufacturing" (WHO, Division of Food and Nutrition Food Safety Unit, 1993) and "HACCP User Guide: Concerted Action No. 7" (Food Linked Agro Industrial Research), to which further reference is recommended. This section will give a brief outline only. Successful implementation of the HACCP system will need appropriately qualified and competent personnel.
The following seven principle activities form the basis for application of the HACCP system Principles.

Principle Activity 1 - Conduct a hazard analysis, identify hazards and specify control measures.
Principle Activity 2 - Identify Critical Control Points (CCP's), using the decision tree.
Principle Activity 3 - Establish critical limits at each CCP.
Principle Activity 4 - Establish monitoring procedures.
Principle Activity 5 - Establish corrective action procedures.
Principle Activity 6 - Establish verification procedures.
Principle Activity 7 - Establish documentation procedures, as appropriate.

APPLICATION OF THE HACCP SYSTEM

The successful application of HACCP is facilitated by a multidisciplinary approach, and requires the full commitment and involvement of the management and workforce. Training and education in the implementation of the principle activities of HACCP are essential for the development and implementation of HACCP plans. HACCP can be compatible with quality management systems, such as the IS0 9000 series and GMP (Good Manufacturing Practices), but it is specifically intended to address key operations that could result in contaminated food.

Step 1. Assembly of the team

The approach to developing a HACCP plan will influence the composition of the HACCP team. In smaller organisations one person may fulfil a number of roles.

Step 2. Description of the product

A full description of the product under study, or intermediate product if only part of the process is being looked at, should be prepared. Information should include all product and process data.

Step 3. Identification of the intended use of the product

The intended use should be based on the expected uses of the product by the end user or consumer.

Step 4. Construction of the flow diagram and facility layout

The format of the flow diagram is a matter of choice: there are no rules for presentation except that each step in the process should be outlined in sequence.

Step 5. On site confirmation of the flow diagram and facility layout

The HACCP team should confirm the processing operation against the flow diagram.

Step 6. Identify and list all the potential hazards associated with each step.

Analyse these potential hazards and assess their likelihood of occurring. Identify the control measures needed to eliminate or minimise the hazards (Principle Activity 1).

All biological, chemical and / or physical hazards that may reasonably be expected should be listed.

Step 7. Establish the Critical Control Points (Principle Activity 2)

After the hazards have been identified, it is necessary to determine whether a step is a CCP for the identified hazard. One approach to determining a CCP is to use a decision tree (refer to next section in the report). This example of a decision tree may not always be appropriate.

Step 8. Establish critical limits for each CCP (Principle Activity 3)

Critical limits must be specified for each control measure at each CCP.
Critical limits may include, for example, chlorine solution strength of the disinfectant used, process temperature/time combinations and microbiological specifications for the product. These limits must ensure that the CCP is under control.

Step 9. Establish a monitoring system for each CCP (Principle Activity 4)

Monitoring is the periodic testing measurement or observation at a CCP, to determine whether a critical limit or target level has been met. The monitoring procedure must be able to detect loss of control at the CCP.

Step 10. Establish corrective actions (Principle Activity 5)

Corrective actions are those actions to be taken when monitoring results show that a CCP has deviated from its specified critical limit.

Step 11. Establish verification procedures

An auditing programme using defined audit procedures, performance testing of equipment and product testing, can be used to verify that HACCP is working effectively and continues to be applicable to the premises and products.

Step 12. Establish record-keeping and documentation (Principle Activity 7)

Adequate, accurate record-keeping and documentation covering all procedures are essential to the application of the HACCP system. Records provide proof of action.

Step 13. Implement the HACCP plan

Once the HACCP plan has been developed for the process, it has to be applied and implemented. The following points will need to be considered in order to facilitate this:

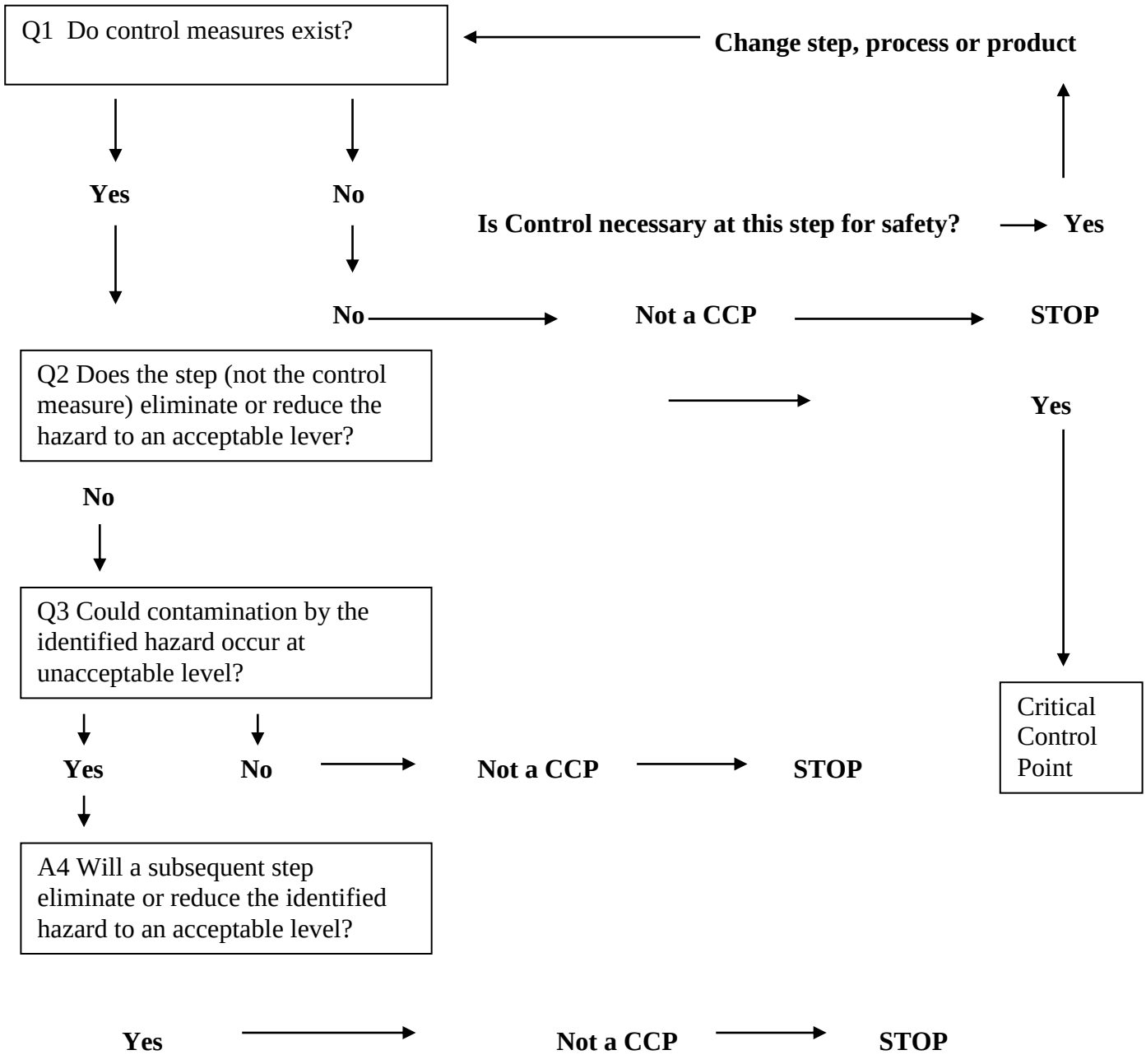
- Allocation of responsibilities
- Development of simple, clear work instructions for the monitoring of CCP's
- Development of record sheets and documentation
- Training
- Allocation of responsibility for decisions on corrective actions.

Step 14. Review the HACCP plan

In addition to the verification procedures outlined above, it is necessary to have a system in place that will automatically initiate a review of the HACCP plan prior to any changes which affect the product safely, for example, changes in cleaning and disinfectant procedures, and product

CRITICAL CONTROL POINT (CCP) DECISION TREE

Apply the decision tree procedure to each step, for each identified hazard, in order to establish the CCP's



GLOSSARY

CONTROL:
To manage the conditions of an operation to establish the state wherein correct procedures are being followed and critical limits or target levels are being met.

CONTROL MEASURE:
Those actions and activities that can be used to eliminate hazards or reduce their impact or occurrence to acceptable levels.

CORRECTIVE ACTION:
The action taken when monitoring at a CCP indicates a potential loss of control or when a critical limit is not met.

CRITICAL CONTROL POINT (CCP):
A point, step or procedure at which control can be applied and a food safety hazard can be prevented, eliminated, or reduced to acceptable levels.

CRITICAL LIMIT:
A value which separates acceptability from unacceptability.

HACCP PLAN:
The written document which is based upon the principal activities of HACCP and which delineates the procedures to be followed to assure the control of a specific process or procedure.

HAZARD:
A biological, chemical or physical agent or condition with the potential to cause harm.

HAZARD ANALYSIS:
The process of collecting and interpreting information to assess the risk and severity of potential hazards.

RISK:
An estimate of the likely occurrence of a hazard.

SEVERITY:
The seriousness of a hazard.

TARGET LEVELS:
Values which are used to assure that critical limits are met.

APPENDIX 2

SOME EXAMPLES OF GOOD FARMING PRACTICES (GFP's)

Biological Hazards:
Pathogenic bacteria, like *Salmonella, Campylobacter, Listeria* and *E. coli*, are the topmost food safety concerns of consumers and governments around the world. But they are also the most difficult to deal with on-farm since they can be transmitted by warm-blooded mammals, birds, insects and even through water, soil and feed. They can seriously reduce the productivity of flocks and herds and they create food safety problems for customers. They're survivors and hard to kill.

No. 1 - Controlling Access:
Hazard: Biological contamination (pathogenic bacteria or viruses) can enter farming enterprises and infect livestock or poultry via wild birds, animals (including pets and rodents), insects, and humans or through the poultry and livestock purchased.

Sample GFP's:

- Purchase poultry and livestock only from hatcheries or producers that have implemented HACCP or quality assurance programs that meet industry standards and your requirements.
- Control access by people and vehicles. Signs won't stop wild animals, birds or insects, but they can have a positive impact on human visitors. Barriers can prevent visitors, and their vehicles, from entering without permission.
- Keep records of visitors, service personnel etc. to permit tracking if problems develop.
- Maintain a clear, level buffer zone adjacent to production areas and provide adequate drainage. Eliminate standing water to discourage rodents and insects.
- Implement disinfection, rodent and pest (flies and other vectors, birds etc.) control programmes.
- Ensure that suppliers (feed mills, hatcheries, cattle transporters, etc.) implement effective bio-security and disinfection programmes for their delivery vehicles to reduce the transfer of hazards between farms

Indoor Operations can also:

- Establish a restricted area inside barns to separate work space/storage areas from the production zone/animals.
- Require clothing and foot wear changes and sanitation measures, like washing up, prior to staff entering the restricted area.
- Prevent farm pets from circulating in the barns.

No. 2 - Water and Feed Supplies and Systems:
Hazard: Bacteria and chemical contamination can enter the operation through either contaminated water or feed.
Sample GFP's:

- Clean, safe water is a priority. Test it regularly and take steps, such as chlorination, to ensure its safety. (In a processing plant this can be a genuine CCP, but on-farm, it should be GFP that's subject to regular monitoring.)
- Purchase feed only from mills that rigorously follow an accredited programme
- Mix your own feed according to industry standards
- Maintain, clean and disinfect water and feed systems to prevent contamination from developing, and use closed systems, where possible, to reduce access by other animals.

No .3 - Barns

Hazard: Bacterial contamination can establish a cycle within a barn.

Sample: GFP's

- Barn interiors should be thoroughly and regularly cleaned and disinfected in accordance with the recommendations set out in individual programmes. Improper cleaning reduces the effectiveness of disinfection and will not break the contamination cycle.
- Exteriors should be cleaned and disinfected routinely to prevent microbiological hazards and organic build-up.
- Workrooms and entryways should be routinely cleaned and disinfected to reduce the potential for contamination and to ensure a clean, safe working environment for staff.
- Disinfection should involve a pressure wash of all walls, ceilings, rafters, fans, heaters, drinkers, feed troughs, floors, cages, pens and other equipment.
- Prompt drying of the barn as a closed system is recommended. Open access and open water will permit recontamination.
- Testing, when properly done, provides a good option for indicating the thoroughness and success of the cleaning and disinfection process.
- Equipment and machinery used in the barn and in the cleaning process should be cleaned and disinfected prior to its next use (e.g. spreading new bedding materials).
- Dispose of residues according to the environmental regulations governing their use and that of the farm site.

No. 4 Shipping Clean Animals and Birds:

Hazard: Faecal contamination from dirty animals and birds improperly withdrawn from feed are two potential sources of biological contamination in processing plants.

Sample GFP's:

- Prevent tag on cattle and sheep by keeping pens, alleys and loading and unloading areas clean and disinfected, avoiding overcrowding, increasing bedding and solving drainage problems.
- Schedule poultry feed withdrawal and catching with the processor to reduce contamination on poultry slaughter lines.

No. 5 - Storage of Milk and Eggs:

Hazard: Improper temperature control of bulk milk tanks or egg coolers can encourage bacteria to grow.

Sample GFP's:

- Implement product specific control procedures for cleaning and disinfecting storage facilities (e.g. milk pre-coolers and bulk tanks, egg coolers or cool rooms).
- Maintain storage temperatures within the ranges established by the product specifications, and establish procedures for monitoring, record-keeping and corrective action.

CHEMICAL AND PHYSICAL RISKS

These hazards - contaminated feed supplies, antibiotic residues, farm chemicals, pesticides, needles, etc. - are as important as the biological hazards. Fortunately, in most cases, producer action to reduce them is easier and can involve the implementation of GFP's that apply the HACCP principles more rigorously.

No. 6 - Farm Chemicals:

Hazard - The improper use or storage of disinfectants, other sanitizing agents, rodenticides, insecticides, pesticides, fungicides, etc. can result in chemical contamination of meat, milk and eggs.

In some on-farm food safety programmes, a HACCP critical control point may be established for treatments with pharmaceuticals. This will require the producer to adopt more detailed procedures for use and monitoring, more rigorous record keeping and a verification procedure involving regular testing.

Sample GFP's:

- Establish procedures for the storage and use of farm chemicals and for monitoring and record-keeping.
- Keep lists and inventories of the chemicals used on the farm.
- Record names of the people responsible for their proper storage, use and monitoring.

No. 7 - Medications and Vaccines:

Hazard: Drug residues from animal health products can result from the improper use of medications and vaccines.

Sample GFP's:

- Use only approved pharmaceuticals, non-feed medications and vaccines for their approved purposes and follow label directions.
- Establish procedures for the use and monitoring of pharmaceuticals, including recording the names of the people administering them, identification of the animals treated, the dosage, date administered and withdrawn, method of application and location of injection.
- Establish procedures for the use and monitoring of treatments with medicated feeds.
- Establish procedures for storage, inventory control and record-keeping of pharmaceuticals, vaccines, medications and medicated drug premixes.
- Establish procedures for responding to deviations from the procedures for the use animal health products, including establishing withdrawal periods, record-keeping, professional consultation, etc.

No. 8 - On-farm processing and mixing of feeds:

Hazard - Chemical and biological residues in feed can occur prior to harvest of the ingredients or during storage, mixing and delivery the feed. Drug residues can occur if medicated rations are improperly mixed or cross-contaminate unmedicated feeds. This can result in the condemnation of carcasses tested positive for drug residues and financial loss to producers.

Feed contamination can also occur as a result of equipment leaking oil, radiator fluids, gas and battery acid or the use of contaminated transportation. Moulds can produce toxins, some of which are carcinogenic. Mould growth can occur in the field or during storage, if conditions are favourable.

Sample GFP's:

- Carefully follow all regulations and commodity specific GFP's concerning on-farm feed mixing and processing.
- Examine all ingredients used in on-farm feed mixing and retain samples.
- Identify, record and safely store medicated or concentrated products.
- Monitor and record the mixing or processing process for each lot of feed (e.g. using checklists and the manufacturer's guidelines, filling out log sheets, checking and recording weights for all feed

components, reviewing for deviations from the formula, and visually checking that the mixed feeds stored in the right bins, etc.).

- Provide for corrective actions (e.g. recording the deviations, determining the safety of using the lot through consultations with your veterinarian, disposal, flushing the mixing system).
- Verify the effectiveness of the GFP by testing feed samples and residues on a regular basis, cross-checking inventory, using logs and reviewing written procedures.

Adapted from "Some examples of on-farm food safety GMP's," 1997, Agricarta, Canada.

APPENDIX 3

POULTRY DISINFECTION PROGRAMME

Drinking Water Disinfection

Water is the most important nutrient for poultry development, but the monitoring and provision of safe drinking water is often overlooked. Disinfection of the water is vitally important to ensure the health of the flock. Studies show that CREDENCE-treated water leads to less mortality, improved weight gains, better feed conversion ratios, improved laying performance and egg quality.

Water Disinfection:

The water should be continuously disinfected, either by hand dosing or by the use of auto-dosing systems. The water is dosed to a sufficient level to achieve a residual 'free available chlorine' level of about 0.5ppm (mgs per litre) at the last drinking water point in the line. The 'free available chlorine' level can be simply measured by using Free Chlorine Test Strips. Where the residual 'free available chlorine' level cannot be measured, then a dosage of 1.5 to 3 ppm has been shown to be effective in clear water, and 4 to 6 ppm in dirty water. This will keep the water disinfected and help prevent the build-up of biofilm and algae

The entire water system should always be kept under positive pressure, with the pipework always full of treated water.

When administering medicaments etc. in the drinking water, the CREDENCE should be neutralised. In conjunction with the medicaments, 2.5g.of skimmed milk (powder) per litre is recommended to be added to the water at a point in the system after it has been disinfected. The milk neutralises the CREDENCE and also colours the water, showing when the medicated water comes on-line and off-line.

Routine Disinfection

1) Foot Baths: all personnel should use footbaths at the entrance point to each house, and on leaving the site. Use CREDENCE at a dosage of 1000ppm, and replenish regularly (at least twice per week).

2) Vehicles: Wheel dips should be provided for entrance and exit to the site. Use CREDENCE at a dosage of 1000ppm, and replenished regularly (at least twice per week).

Transport vehicles and equipment should be thoroughly cleaned and then disinfected with a CREDENCE solution of 500ppm between each run.

3) Entrance to Poultry Houses: Daily wash and disinfect the area immediately outside the entrance to each poultry house using a CREDENCE solution strength of 500ppm.
4) Roof Spraying: During hot weather periods, where water is used to cool houses by spraying or sprinkling it down the roof, it should be treated with CREDENCE at a dosage of 5ppm.
5) Misting/Fogging: Misting or fogging is sometimes used to reduce aerial cross infections between birds, or to minimise the effects of hot weather, provided it does not cause high humidity levels, which cause stress with the birds. The water used should be treated with CREDENCE at a dosage of 5ppm.
6) Hand Washing: It is necessary to wash hands in a disinfectant solution at certain critical points e.g. before collecting eggs. Use CREDENCE solution strength of 100ppm.

Terminal Disinfection

1) Remove all birds and movable equipment. Remove all food. Hang up all fixed, adjustable equipment, such as the feeder and water systems.
2) Brush, blow or vacuum all dirt and dust from vents, ducts, posts, ledges, light fittings, walkways, steps, equipment or any other areas where organic material from the outgoing batch may be found. Move from top to bottom.
3) Remove all litter and debris from the house, scraping where necessary, and remove to a safe point as far away as possible from the house (at least 500m.), where it can be heaped, covered and composted.
4) Pressure hose down all items and areas (using a detergent, if necessary). Manually clean difficult areas. The run-off water should be directed to a pit at the site edge, from where it can be tankered away.
5) Disinfection should commence as soon as possible after washing. A CREDENCE solution is power sprayed to thoroughly wet all roofline, wall and floor surfaces, including vents, ducts etc. Areas where electrical fittings are exposed should be treated by fogging. Surfaces should be uniformly sprayed at 100 litres of CREDENCE solution per $500M^2$, and then left to dry off. Move from top to bottom, and back to front. Use a dosage of 500ppm for porous surfaces (e.g. concrete) and 350ppm for non-porous surfaces (e.g. tiles).
6) Hose down to clean all equipment removed from the house, and then disinfect using a CREDENCE solution of 500ppm.
7) The entire water system should be drained. Where there is algae growth and biofilm accumulation, this should be physically removed from the tanks and the pipework flushed with an acid cleaner (e.g. vinegar). The entire system should then be flushed out to remove debris. CREDENCE should be added to the header tank at a dosage of 25ppm, and the entire system filled with the solution, and allowed to stand for 30 mins. The system is then drained and refilled with fresh water.
8) Bedding may be introduced 24 hours after spraying is completed.
9) For breeder and turkey fattening houses, a second disinfectant spray/fog is recommended after 7 days, before equipment is returned or bedding introduced.

Egg Disinfection, Incubators and Hatchery Rooms

1) Eggs should be collected at least 4 times daily – more in hot weather. Cleaning and disinfection should be carried out immediately.
2) Floor eggs and nest eggs should never be mixed. Floor eggs should not be incubated.
3) Temperature of cleaning and disinfectant solutions is important. Solutions should be warmer than the eggs, so that the egg membrane expands to seal the shell thereby preventing pathogens and solutions from entering the egg.
4) Only clean, whole eggs can be disinfected. These eggs should be disinfected by spraying with a CREDENCE solution of 100ppm at a temperature of 52^oC, or by dipping for about 3 mins. at 42^oC. It is important to maintain the CREDENCE solution at a minimum strength of 100ppm.
5) Allow the eggs to dry before packing.
6) New eggs introduced to setters should be fogged with a CREDENCE solution of 100ppm, sufficiently to just wet the surface of the eggs.
7) The water used to humidify the incubators should be disinfected using CREDENCE at a dosage of 5ppm, to prevent cross infection, and algae or biofilm build up.
8) The floors, walls, tables, shelves etc. of the storage rooms should be cleaned then disinfected each day or shift, using an CREDENCE solution of 500 ppm.

Disease Outbreaks

Such situations would include outbreaks of Marek's disease or Newcastle disease, for example

1) The procedures for isolation, cleaning and disinfection should be completed as given in the previous disinfection programme.
2) The CREDENCE solution strength for disinfection of the walls, floors, equipment etc. should be 1000ppm.

APPENDIX 4

SWINE DISINFECTION PROGRAMME

Routine Disinfection

Foot Baths: all personnel should use footbaths at the entrance point to each house, and on leaving each house. The footbath should be combined with the use of a stiff brush to help penetrate and remove hardened material. Use CREDENCE at a dosage of 1000 ppm, and replenish regularly (at least twice per week). Use of footbaths will help prevent the transport of contaminated materials from one production area to another.

It should be remembered that personnel movement should be in the direction of high-risk areas to low-risk areas. Thus, farrowing rooms should be visited first in the day, followed by weaners, and then fatteners.

Vehicles: wheel dips should be provided for entrance and exit to the site. Use CREDENCE at a dosage of 1000 ppm, and replenish regularly (at least twice per week). Transport vehicles and equipment should be thoroughly cleaned, and then disinfected with a CREDENCE solution of 500 ppm between each run. Many disease outbreaks (including Blue Ear (PRRS), Classical Swine Fever and *Mycoplasma pneumonia)* have been attributed to the use of contaminated vehicles.

Entrances to houses and pathways between houses: These areas should be kept clear of waste and refuse that can harbour vermin, the vectors of many *Salmonella* species. They should be regularly cleaned, followed by pressure spraying with a CREDENCE solution of 500ppm. If they have a pebble surface, they should be regularly sprayed to ensure no weed growth (that would provide cover for vermin).

Dry sow house/ service area: the general area behind the sows should be regularly cleaned, followed by disinfection with a CREDENCE solution of 500 ppm, (the sows will still be present). This will help prevent the occurrence of metritis, cystitis and kidney infections, usually caused by *E. coli* species. The service area should be thoroughly cleaned and the disinfected with a CREDENCE solution of 1000 ppm when vacated (usually on a weekly basis). This area has a lot of pig and operator movement and the act of service or insemination may put the sow at risk from environmental contamination.

Misting/Fogging: misting or fogging is sometimes used to minimize aerial cross infections at least on a daily basis, whilst the pigs are still present. This is particularly relevant for prevention of respiratory diseases, such as *Mycoplasma pneumonia,* (Enzootic pneumonia). The water should be treated with a CREDENCE solution of 50 ppm.

Sow washing: sows need to be washed prior to farrowing to prevent cross infections to new-born piglets. The sow can act as the source of *Haemophilus parasuis* (Glasser's disease), or *Staphylococcus hyicus* (Greasy Pig disease), and be responsible for infecting her offspring. A CREDENCE solution of 500 ppm is well tolerated by the sow, for washing purposes.

Terminal Disinfection

(Farrowing Rooms, Boar Pens, Weaner Houses, Fattener Houses)

Remove all pigs and movable equipment, including feeders and drinkers, pen separators, crates, lamps etc.
Remove unused feed. Brush, blow or vacuum all dirt, debris and dust from vents, ducts, posts, ledges, light fittings, walkways, steps, equipment and any other areas where organic matter from the outgoing herd may be found. Move from top to bottom.

Remove all litter and debris from the house, scraping where necessary, and remove to a safe point as far away as possible from the house (at least 500m), where it can be buried or composted.

Pressure hose down all items and areas (using a detergent, if necessary). Manually clean difficult areas. The run-off water should be directed to a pit at the site edge, from where it can be tankered away.

Disinfection should commence as soon as possible after washing. A CREDENCE solution is power sprayed to thoroughly wet all roofline, wall and floor surface areas, including vents, ducts etc. Areas where electrical fittings are exposed should be treated by fogging. Surfaces should be uniformly sprayed at 100 litres of CREDENCE solution per 500 M^2, and then left to dry off. Move from top to bottom, and back to front. Use a dosage of 500 ppm.

Hose down and clean all equipment removed from the house, and then disinfect using a CREDENCE solution of 500 ppm.

The entire water system should be drained. Where algae growth and biofilm has accumulated, this should be physically removed from the tanks and the pipework flushed with an acid cleaner (e.g. vinegar). The entire system should then be flushed out to remove debris. CREDENCE should be added to the header tank at a dosage of 25 ppm, and the entire system filled with the solution, and allowed to stand for 30 minutes. The system is then drained and refilled with fresh water.

In the period prior to re-stocking, the entire housing area should be fogged weekly with CREDENCE at a dosage of 50 ppm. All houses should be empty of stock for at least 4 weeks, and preferably 6 weeks, prior to re-stocking.

Water Disinfection

Water can be disinfected either by hand dosing or by the use of auto-dosing systems. To achieve a satisfactory level of water quality it should be dosed with CREDENCE to give a residual ' free available chlorine' level of about 0.5 ppm (mgs. per litre) at the last drinking water point in the distribution system. The 'free available chlorine' level can be simply measured by using Free Chlorine Test Strips. Where the 'free residual chlorine' level cannot be measured, then a dosage of 1.5 to 3 ppm has been shown to be effective in clear water, and 4 to 6 ppm in dirty water. This will keep the water disinfected and help prevent the build-up of biofilm and algae.

The entire water system should always be kept under positive pressure, with the pipework always full of treated water.

When administering medicaments etc. in the drinking water, the CREDENCE should be neutralized. In conjunction with the medicaments, 2.5 g. of skimmed milk (powder) per litre is recommended to be added to the water at a point in the system after it has been disinfected. The milk neutralizes the CREDENCE and also colours the water, showing when the medicated water comes on-line and off-line.

Disease Outbreaks

Such situations would include outbreaks of neonatal diarrhoea in the farrowing rooms; Blue Ear Disease in the unit; or *Mycoplasma* in the fatteners.

1) The procedures for isolation, cleaning and disinfection should be completed as given in the previous disinfection programme

2) The CREDENCE solution strength for disinfection of the walls, floors, equipment etc. should be 1000 ppm.

APPENDIX 5

Drinking Water Quality Standards for Poultry			
Contaminant or Characteristic	**Level considered average**	**Maximum acceptable level**	**Remarks**
Total Bacteria	0/ml	100/ml	0/ml is desirable
Coliform Bacteria	0/ml	50/ml	0/ml is desirable
Nitrogen Compounds Nitrate	10mg/l	25mg/l	Levels from 3 to 20mg/l may affect performance
Nitrate	0.4mg/l	4mg/l	
Acidity and hardness pH	6.8-7.5	-	A pH of less than 6.0 is not desirable. Levels below 6.3 may degrade performance
Total hardness	60-180	-	Hardness levels less than 60 are unusually soft, those above 180 very hard
Calcium	60mg/l		
Chloride	14mg/l	250mg/l	Levels as low as 14mg/l may be detrimental if the sodium level is higher than 50mg/l
Copper	0.002mg/l	0.06mg/l	Higher levels produce a bitter flavour
Iron	0.2mg/l	0.3mg/l	Higher levels produce a bad odour and taste
Lead	-	0.02mg/l	Higher levels are toxic
Magnesium	14mg/l	125mg/l	Higher levels have a laxative effect. Levels greater than 50mg/l may affect performance if the sulphate level is high
Sodium	32mg/l	-	Levels above 50mg/l may affect performance if the sulphate or chloride level is high
Sulphate	125mg/l	250mg/l	Higher levels have a laxative effect. Levels above 50mg/l may affect performance if magnesium and chloride levels are high
Zinc	-	1.50mg/l	Higher levels are toxic

APPENDIX 6

CREDENCE GUIDELINES FOR THE DISINFECTION OF WELLS

Disinfection of Wells

After construction of a well and installation of the pump, or if biological pollution has entered the well, it should be disinfected immediately to kill any microorganisms present.

To disinfect a well the following procedure is recommended:

1) Dissolve 10 CREDENCE tablets in 50 litres of water, in an open area.

2) Pour half the solution into the well. Operate the pump until the water is pumped out (or from all the opened taps in a household) distinctly smells of chlorine.

3) Stop pumping and add the rest of the solution to the well.

4) Wait one hour and pump again (with all taps open in a household) for several minutes.

5) Stop pumping and leave the well for twelve hours.

6) At the end of this time pump to waste until the residual chlorine level reaches <2mg/l.

7) Refill the system with potable water.

APPENDIX 8

CREDENCE DILUTION CHARTS

Water Disinfection						
Litres of Water Treated per Tablet						
Dosage: ppm						
Tablet	1	2	3	4	5	6
CREDENCE	5000	2500	1666	1250	1000	833

CREDENCE DILUTION CHARTS

Environmental Disinfection							
Litres of Water Treated per Tablet							
Disinfectant Solution Strength: mg/l (ppm)							
Tablet	5 mg/l	25mg/l	50mg/l	100mg/l	350mg/l	500mg/l	1000mg/l
CREDENCE	1000	200	100	50	15	10	5

CREDENCE DILUTION CHARTS

Environmental Disinfection							
No of Tablets per 100 litres							
Disinfectant Solution Strength: mg/l (ppm)							
Tablet	5mg/l	25mg/l	50mg/l	100mg/l	350mg/l	500mg/l	1000mg/l
CREDENCE	0.10	0.5	1	2	7	10	20