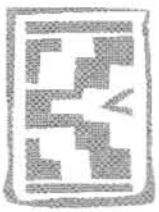

Continuous disinfection as a means to control infectious diseases in poultry. Evaluation of a continuous disinfection programme for broilers

R.R. BRAGG[1] and P. PLUMSTEAD[2]

ABSTRACT

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A full continuous disinfection programme, consisting of disinfection during cleanout of poultry houses prior to placement of chickens, disinfection of the drinking water and spray disinfection of the birds during production was evaluated in broilers under experimental condition as well as under field conditions.

Under controlled conditions, the experimental design consisted of three groups, two of which were control groups. Each group comprised 300 chickens. In one of the control groups, no disinfection of the pens was undertaken prior to the placement of the chickens. In the other control group, disinfection of the pens prior to placement of the birds was carried out using a glutaraldehyde-based product. In the test group, disinfection prior to placement was done. The drinking water of these birds was treated continuously and the birds were sprayed with a non-toxic disinfectant during production.

Production parameters, such as growth rate, feed conversion ratio and feed consumption, of the birds in the three groups were monitored. In addition, all mortalities in the different groups were recorded and classified into diseases of an infectious nature, non-infectious nature and unknown category. Bacterial counts were also done on a weekly basis from the different pens.

In this experiment, it was shown that the full continuous disinfection programme resulted in a lower number of mortalities caused by infectious agents as well as a reduction in the bacterial counts in the pens treated with the full continual disinfection programme.

The full continuous disinfection programme was also tested on a commercial poultry farm in the Northern Cape Province of South Africa. Two production houses of 3 500 birds were randomly selected as test houses for the full continuous disinfection programme. Another similar house, which received day-old chicks from the same batch as the other two houses, was selected as the control house; it received the routine disinfection procedure prior to placement of the chicks. During the course of this experiment, a severe outbreak of Newcastle disease was experienced on this farm. It was demonstrated that, in the face of this severe challenge, the full continuous disinfection programme controlled the spread of the disease in both the houses where it had been applied at a stage when in every other house (including the control house) on the farm birds were suffering very high mortalities.

Keywords: Broilers, continuous disinfection, disease control, Newcastle Disease, poultry

INTRODUCTION

In many parts of the world, the practice of clean out of poultry production facilities after each crop is routinely carried out (Morales, Gonzalez, Tandron & Martinez 1992; Fututa 1993; Davies & Wray 1995;

[1] Department of Microbial, Biochemical and Food Biotechnology, University of the Free State, P.O. Box 339, Bloemfontein, 9300 South Africa. E-mail: BraggRR@sci.uovs.ac.za

[2] Center for Animal Nutrition, Animal Nutrition and Animal Production Institute, Private Bag X2, Irene, 1675 South Africa

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Meroz & Samberg 1995; Ranganalhan, Ramadoss & Murugan 1995; Davison, Benson & Eckroade 1996; Rose, Beaudeau, Drouin, Toux, Rose & Colin 2000). Much effort and cost is spent ensuring that the poultry house is as pathogen-free as possible before the placement of new chicks into the house. However, once the birds have been placed, little emphasis is placed on continuous disinfection and biosecurity. The control of infections diseases, once the birds have been placed, involves the use of antibiotics for the control of bacterial diseases and the vaccination of the birds for the control of the viral diseases and some of the bacterial diseases. There are, however, certain problems and potential problems when relying on these approaches for the effective control of diseases. This included worldwide concern about the use of antibiotics in production animals and the development of antibiotic resistance in bacteria which appears to be associated with this practice.

Vaccines remain an effective way to control diseases, but there are also potential problems associated with the use of vaccines. These can include breaks in the vaccine cold chain, incorrect vaccine application, use of incorrect vaccines for particular diseases and the ability of the pathogen to change in its antigenic expression.

There is thus a need to investigate other options for the control of infections diseases in poultry production. Some researchers have investigated the possibilities of disinfecting the air in poultry houses (Sobih, Dosoky & Ismail 1991; Vinokurov & Kholodov 1991). Attempts were also made to use formalin fumigation for the disinfection of houses once the chickens had been placed into the houses, but respiratory problems associated with this practice in day-old chicks have been reported (Jayaramu, Gowda & Viayasarathi 1999). There are also reports of the treatment of the drinking water of chickens during production (Abdel-Wahed, Ali, Bafawy & El-Agrab 1994; Valerio, Larios, Vidal, Gutierrez & Rodriguez-Ferri 1997).

A number of poultry pathogenic organisms causing diseases have been recorded in commercial poultry in South Africa. These include rhinotracheitis virus (Buys, Du Preez & Els 1989a), swollen head syndrome virus (Buys *et al.* 1989b), infectious bursal disease virus (Du Preez & Buys, 1980), adenovirus 127 (Bragg, Allwright & Coetzee 1991), avian pneumovirus-like agent (Maharaj, Thomson & Da Graca 1994); *Haemophilus paragallinarum* (Bragg, Coetzee & Verschoor 1993), chicken anaemia virus (Wicht & Maharaj, 1993) *Ornithobacterium rhinotracheale* (Travers, Coetzee & Gummow 1996), *Mycoplasma synoviae* (Buys 1976). The most serious disease of poultry in this country is Newcastle disease (ND) that is responsible for sporadic outbreaks of disease in South Africa and is regarded as endemic to the region (Kaschula, Canham, Diesel & Coles 1946; Cilliers 1994). Molecular surveys of ND virus from the 1993 to 1995 (Herczeg, Wehmann, Bragg, Travassos Dias, Hadjiev, Werner & Lomniczi 1999) have revealed that there were at least two genotypes of ND virus in South Africa. One genotype of infection in the 1993 to 1995 outbreaks in southern Africa appeared to be an indigenous virus, while there was evidence that another genotype was introduced to the region at the same time.

The product, Virukill, is a patented formulation of a quaternary ammonium compound, in which the efficacy of the active substance has been boosted without increasing its toxicity. Virukill consists of a modification based on a 12% active ingredient which is didecyldimethyl ammonium chloride (DDAC). This product has been shown to have a very low toxicity (data not shown) and a high efficacy against poultry viruses and bacteria (data not shown). Virukill has been registered in South Africa (Act 36 of 1947) for use in the drinking water and for spraying of birds, thus substantiating the above statements on toxicity and efficacy. Because of this low toxicity and high efficacy, the possibilities of using this product for continuous disinfection during poultry production was investigated. The advantages of using Virukill is that a single product can be used for all of the biosecurity applications on a poultry farm, including disinfection of hard surfaces during cleanout, treatment of the drinking water and spraying of the birds during production.

In these experiments, the concept of using a non-toxic disinfectant for the continuous disinfection on broilers, held under experimental conditions as well as under field conditions, were undertaken and are reported on.

METHODS AND MATERIALS

Experimental design and placement of chickens under controlled conditions

Facilities at the Animal Nutrition and Animal Production Institute, Irene were used. These facilities consisted of three, closed, and ventilated chicken rooms. A total of six pens are located in each room,

each with a total floor area of 2.7m^2. A stocking density of not more than 19 chickens per m^2 is recommended for these pens, thus allowing a maximum of 50 birds per pen to be kept.

The experiment was run in the form of a 3 x 1 factorial design on as-hatched Cobb broilers. Using six pens per treatment in a randomized block design, a total of six repetitions for each treatment, with a total of 50 birds per repetition, were obtained. Thus, a total of 300 chickens for each of the three different treatments (see below) were used. The experimental design is such that statistically significant differences ($P<0.05$) of 2–2.5% could be detected.

Treatments

Treatment 1 consisted of a full pre-disinfection of the pens with Virukill, which included washing with a 100 ppm dilution at 1 ℓ/m^2, and disinfection with a 1 % solution at 600 mℓ/m^2. These pens were also subjected to pre-fogging with a 1 % solution of Virukill prior to placement of birds. In addition to these disinfection processes, the pens also received a full continuous disinfection programme, which consisted of continuous application to the drinking water of the chickens with a 100 ppm dilution of Virukill, as well as daily spraying of the chickens with a knapsack sprayer at a 1 % dilution of Virukill. Chickens were sprayed twice a day up to two weeks of age, thereafter once a day.

The second set of treatments consisted of a full pre-disinfection process which consisted of a washing stage with a 100 ppm soap solution at 1 ℓ/m^2, followed by disinfection with a 1 % dilution of commercially available glutaraldehyde based disinfection at a rate of 1 ℓ/m^2.

The control group consisted of no pre-disinfection and no continuous disinfection.

Management of chickens

All birds were housed on clean wood shavings obtained from the same source. Each pen was equipped with two tube feeders and three chick fonts which had been disinfected before placement.

On day 1, the temperature in all of the pens was set at 32 °C. This temperature was decreased every second day by 2 °C until a temperature of 21 °C was reached. Thereafter the temperature remained constant at 21 °C for the duration of the production period which equalled that of the duration of the experiment.

The lighting pattern provided continuous lighting for the first 48 h. Thereafter a light cycle of 23 h light and 1 h darkness was followed throughout this experiment.

No vaccination programme was implemented in these pens.

The birds were placed on a commercially available three-phase feeding system. The total feed intake of the birds was recorded and corrected for any mortalities occurring in the pens. The birds were weighed on a weekly basis on days 0, 7, 14, 21, 28, 35 and 42 in order to determine their growth rates.

All mortalities were recorded and the dead birds were weighed and subjected to post mortem examination. The diagnoses were placed into three categories, namely death caused by non-infectious causes, death due to infectious causes (based on both lesions and laboratory confirmation) and deaths for which no causes could be determined, usually as a result of the post mortem decomposition of the carcasses.

Microbiological examination of pens

Swab samples were collected from each of the drinkers, walls and each feeder in each pen on a weekly basis. Ten mℓ water samples of the drinking water and 10 g litter samples were collected in a sterile plastic bag from each pen on a weekly basis.

Bacterial counts in all of these samples were determined spectrophotometrically according to the methods established by Pienaar, Coetzee & Bragg (1994, 1995). Basically, brain heart infusion broth (BHI) was inoculated with the swab samples and incubated at 37 °C for 6 h after which time the optical density (OD) at 540 nm was read. Pienaar *et al.* (1995) established that the OD reading after 6 h incubation is a representation of the bacterial load in the starting sample. A 1 mℓ water sample was used to inoculate 10 mℓ BHI and incubated for 6 h to allow for bacterial determinations using the method of Pienaar *et al.* (1995). A 1 g sample of the litter was used to inoculate 10 mℓ of BHI and this was processed in the same way as the water samples.

Field experiment on a commercial poultry farm

A commercial poultry farm, consisting of 12 houses, each capable of housing 3 500 birds in a multi-age operation was selected for the field experiment. Three of the houses were chosen as they were empty at the time the experiment was conducted

but were due to be stocked shortly with day-old chicks.

In two of these houses (the "experimental houses") the full continuous disinfection process (see below), was to be applied, while the remaining house was selected as the "control" house. The latter, after clean-out, was disinfected according to the routine methods used on the farm. It was washed with a 100 ppm detergent solution, after which it was disinfected with a 1 % solution of a gluteraldehyde-based solution. Once the disinfection process was completed, bedding for the chicks, consisting of wood shavings was introduced into the house and the chicks were placed in it. All of the usual production procedures (including feeding, provision of drinking water and vaccination programme) used on the farm were implemented in all of the houses.

The vaccination programme comprised administration of ND and infectious bronchitis vaccines when the chickens were 1 day old, the procedure being done in the hatchery, vaccination against ND when they were 18 days old, using a spray method, and infectious bursal disease (IBD) when they were 14 and 18 days old using an intermediate strength vaccine which was applied to the drinking water.

In the experimental houses, the floors were first washed with a 100 ppm Virukill solution at a rate of 1 ℓ/m^2. After washing, the entire inside of each house was disinfected with a 1 % Virukill solution at a rate of 600 $m\ell/m^2$. Once the houses were dry, all of the routine production parameters used on the farm, which were the same as those used in the control house were implemented. These birds also received the same vaccination programme. Apart from the use of Virukill in the complete continuous disinfection programme, the birds in all three houses were treated in a very similar manner.

Chicks used for placement in all three houses arrived in the same shipment, and were randomly placed into the three houses, so that each house contained 3500 birds.

The only additional biosecurity aspect implemented in the control house was a footbath for use by the personnel. It was placed at the entrance and contained a 2 % gluteraldehyde-based product, which was changed every second day. In the case of the experimental houses the footbaths consisted of a 2 % Virukill solution, which was changed every second day.

The drinking water of the chickens in the experimental houses was treated with 100 ppm Virukill on a continuous basis, and the birds were sprayed with a 1 % aqueous solution of Virukill by means of a knapsack sprayer on a daily basis at a rate of 4 $m\ell$ per bird.

All production parameters, such as feed conversation ratios, growth rates and daily mortalities were recorded and submitted for evaluation.

Virus isolation was done in 10-day-old SPF eggs (Valo SPF eggs supplied by Immunovet Services, P.O. Box 6035, Halfway House, 1685) according to standard methods (Mascoli & Burrell 1965; Versteeg 1985). Isolated virus was identified by a haemagglutination and haemagglutination inhibition test according to standard methods (Burleson, Chamber & Weidauk 1992).

RESULTS

Growth rates under experimental conditions

The weekly mass of the birds is given in Table 1, and a graphic representation of the growth rates is depicted in Fig. 1.

The 1994 Cobb standards for weekly body mass and cumulative feed intake, as supplied by the Cobb Breeding Company Ltd, are provided as a comparison in each of the tables.

It can be seen from the data presented in Table 1 and Fig. 1 that the best average final mass occurred in the chickens in the pens receiving the full continuous disinfection programme although these differences were not found to be statistically significant ($P< 0.05$).

Feed conversion ratio under experimental conditions

The feed conversion ratio (FCR) was calculated for the chickens in two different ways. FCR 1 is the feed conversion ratio which is calculated as the average feed intake per bird over the average live mass of the bird. FCR 2 is calculated from the total feed intake per pen over the total body mass gain (corrected for mortalities). Both FCRs for the three different groups of chickens (six repetitions per group) and given in Table 2.

It can be seen from the data presented in Table 2 that the best FRC, calculated by either method, was found in the pens on the full continuous disinfection programme. These results were, however found not to be significantly different ($P < 0.05$).

Mortalities under experimental conditions

The weekly mortalities rates are given in Table 3 and Fig. 2, while the numbers of birds falling into each of the three diagnostic categories are presented in Table 4 and Fig. 3.

It can be deducted from the results presented in Table 3 and Fig. 2 that the mortalities in all of the pens were higher than would have been expected from normal production parameters. However, the mortalities that occurred in the pens on the continuous disinfection programme were lower than in the other pens. The highest mortality rates were seen in the pens which had received only pre-disinfection where a final mortality rate of 24.66 % was obtained. The mortality rate in the pens which had

TABLE 1 Mean weekly growth rates, representing the mean mass of chickens in six different pens per treatment. The Cobb production standard is included for comparison

Age (weeks)	Average body mass			
	Continuous disinfection	Pre-disinfection only	No treatment	Cobb standard
1	153.55	147.15	155.13	190
2	404.29	337.67	402.84	444
3	768.27	688.00	786.83	800
4	1 268.41	1 141.28	1 274.81	1 234
5	1 790.65	1 689.01	1 774.76	1 700
6	2 248.38	2 171.90	2 243.46	2 178

TABLE 2 Final feed conversion ratio 1 (FCR1) calculated as the average feed intake per bird per average live mass of the bird), representing the mean mass of chickens in six different pens per treatment. The Cobb production standard is included for comparison. Final Feed conversion ratio 2 (FCR2) calculated as the total feed intake per pen per total body mass gain (corrected for mortalities)

Final feed conversion	Average body mass			
	Continuous disinfection	Pre-disinfection only	No treatment	Cobb standard
FCR1	1.80	1.84	1.89	1.80
FCR2	1.92	2.18	2.01	

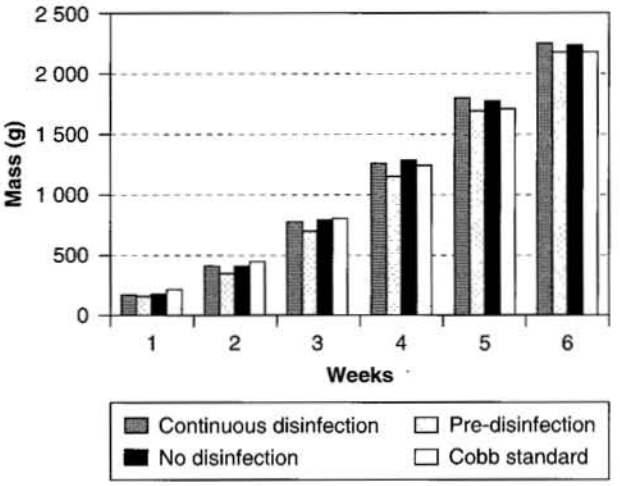

FIG. 1 Graphic representation of the mean growth rates obtained for the birds in pens treated with the full continuous disinfection programme with Virukill, as compared to birds in pens with only a pre-disinfection and birds from pens with no disinfection. The Cobb production standard is included as a comparison

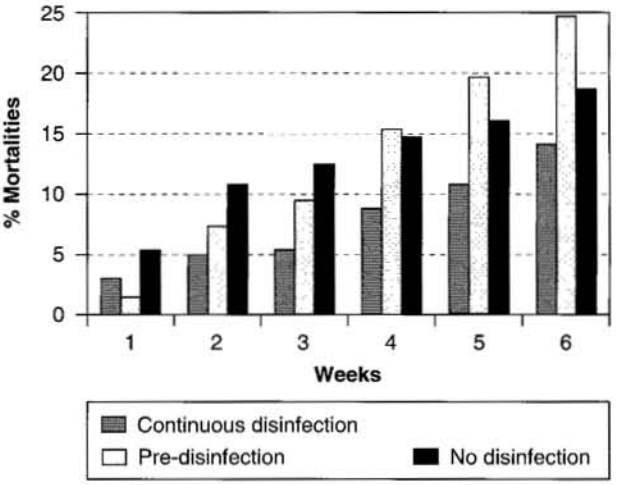

FIG. 2 Graphic representation of the cumulative percentage mortalities in the birds in the pens treated with the full continuous disinfection programme with Virukill, as compared to birds in pens with only a pre-disinfection and birds from pens with no disinfection

TABLE 3 Cumulative weekly mortalities in the birds in the six different pens per treatment

Age (weeks)	Cumulative percent mortalities		
	Continuous disinfection	Pre-disinfection only	No treatment
1	3.00	1.33	5.33
2	4.76	7.33	10.67
3	5.33	9.33	12.33
4	8.67	15.33	14.67
5	10.66	19.66	16.00
6	14.00	24.66	18.66

TABLE 4 Three categories into which the cause of death in the three groups of birds were placed

Category of mortality	Total no. of mortalities in each category (%)		
	Continuous disinfection	Pre-disinfection only	No treatment
Infectious	7 (17.5 %)	24 (29.6 %)	15 (30.0 %)
Non-infectious	29 (72.5 %)	31 (38.3 %)	30 (60.0 %)
No diagnosis	4 (10.0 %)	26 (32.1 %)	5 (10.0 %)

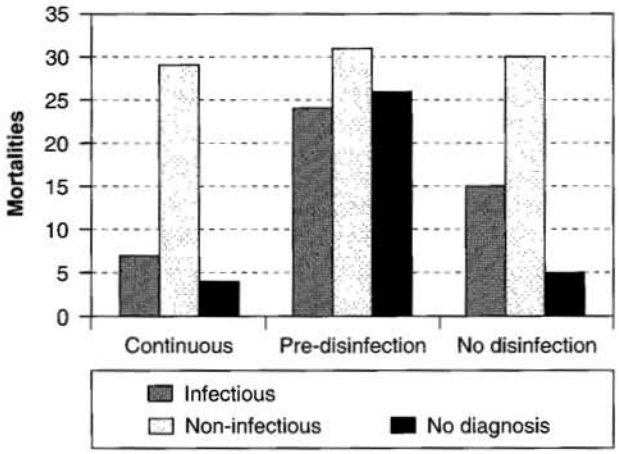

FIG. 3 Graphic representation of the different categories of causes of mortalities obtained in the birds in the pens treated with the full continuous disinfection programme, as compared to those in pens which had received only a pre-disinfection and those in pens which had not been disinfected

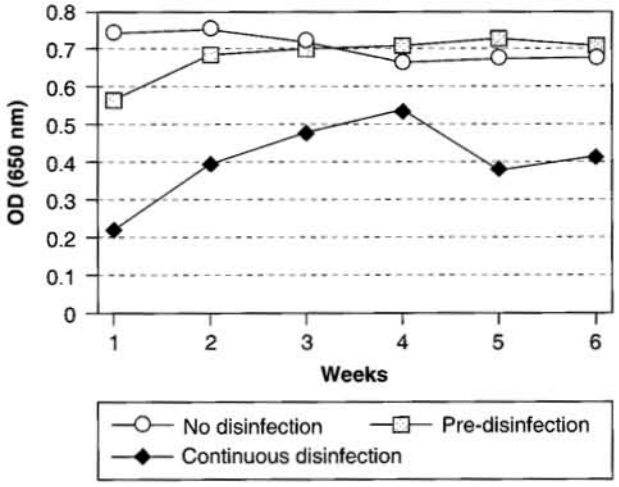

FIG. 4 Graphic representation of the overall bacterial loads in the different pens

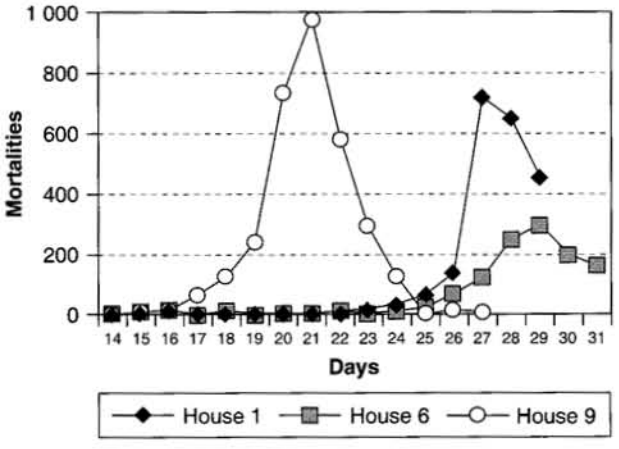

FIG. 5 Graphic representation of the daily mortality figures, from day 15 for houses 1 and 6 (both on a full continuous disinfection programme) and house 9 (control house)

TABLE 5 The mean weekly bacterial load (as calculated from the mean optical density at 540 nm) for samples collected from the litter, drinking water, feeders and walls collected from the six different pens per treatment groups

Weeks	Mean optical density reading (representing bacterial counts)		
	Continuous disinfection	Pre-disinfection only	No treatment
1	0.221	0.567	0.739
2	0.394	0.682	0.749
3	0.477	0.698	0.717
4	0.540	0.705	0.662
5	0.379	0.727	0.673
6	0.416	0.706	0.676
Mean	0.398	0.681	0.703

TABLE 6 Daily mortality records of the chickens in the three houses selected for the continuous disinfection programme evaluation. Houses 1 and 6 were on the full continuous disinfection programme, while house 9 was the control house

Date	Daily mortality records		
	House 1	House 6	House 9
1	1	6	9
2	5	3	1
3	7	5	8
4	13	7	11
5	7	17	35
6	17	13	12
7	10	2	8
8	6	7	4
9	4	5	2
10	4	6	1
11	4	4	3
12	2	3	2
13	4	2	3
14	2	1	1
15	4	2	6
16	14	7	16
17	1	1	66
18	3	13	128
19	6	5	242
20	5	2	733
21	2	3	981
22	13	10	581
23	20	3	294
24	34	10	125
25	65	23	0
26	138	67	14
27	720	121	8
28	650	247	–
29	454	300	–
30	–	200	–
31	–	160	–

received no pre-disinfection was lower than the mortalities in the pens which received pre-disinfection only. The mortality figure for these pens was 18.66 %. The lowest mortalities were recorded in the pens receiving the full pre disinfection with Virukill as well as the full continuous disinfection programme. The mortality rate in these pens was 14% during this experiment. It must be stressed that the mortality rate in all of the pens were exceeding high as judged by general production standards in South Africa. Applications of the continuous disinfection programme had no effect on the mortality rate caused by non-infectious causes. The latter are similar for each group (Table 4).

Microbial examination of pens under experimental conditions

The combined microbial counts obtained from all of the different samples collected on a weekly basis from the different pens on the different treatments are given in Table 5 and Fig. 4.

Significantly lower bacterial counts were obtained in the pens on the full continuous disinfection programme when compared to those of the other two treatments.

Field experiment on a commercial poultry farm

Daily feed consumption records were submitted and weekly average mass of the chickens were supplied (data not shown) for each of the three houses. Daily mortality records were also provided for each of the houses. These results are given in Table 6 and Fig. 5 (only from day 15 in Fig. 5) for all three houses.

For the first 14 days of the experiment (Table 6), the daily mortalities in the three houses were very similar. In the two experimental houses (numbered house 1 and house 6), the total mortality rate for the first 14 days was 90 for house 1 and 83 for house 6. A higher mortality rate was recorded in the con-

trol house (house 9) where 97 chickens were found to have died.

On day 14 of this experiment, ND was diagnosed in other houses on the farm by means of post mortem examinations and isolation and identification of NDV according to the methods described above.

From day 16, an increase in mortalities was recorded in the control house and a diagnosis of ND was made and confirmed. On day 16 chickens in all houses on the farm, except those in the two experimental houses which were receiving the full continuous disinfection programme were experiencing high levels of mortalities.

On day 20, the farmer was advised by a veterinarian not involved in the experiment to stop the full continuous disinfection programme. The resulting increase in mortalities is depicted in Table 6 and Fig. 5.

On day 27, the producer culled all surviving birds in House 9, as there were very few birds left in this house. On day 30, the producer culled all the remaining birds on the farm, including those surviving in houses 1 and 6, in order to introduce a complete clean out and disinfection of all the houses on the farm.

DISCUSSION

One of the main objects of these experiments were to establish if the use of a non-toxic disinfectant in the drinking water and to spray the birds in a poultry house on a continuous basis had any negative impact on production. It was demonstrated that there were no statistically significant differences in the growth rates and feed conversion ratios of the birds on the full continuous disinfection programme and the two control groups under experimental conditions. It can thus be concluded that the use of the full continuous disinfection programme has no negative effects on the production parameters of broilers.

Although the differences in the production parameters between the three different groups were found to be not statistically significant, it can be seen that better production parameters were nevertheless obtained in the birds in the pens on the continuous disinfection programme. Imanishi (1990) reported on improvements in production as a result of better biosecurity when compared to those obtained in a "normal" disinfection programme, which supports the results obtained in the first experiment.

The final live mass after 42 days was found to be higher in all three treatments when compared to the Cobb standard. This could possibility be attributed to the lower stocking densities which resulted from the high mortality rates obtained in all of the pens. The lowest body mass was in the birds that were housed in the pens which had received no pre-disinfection and no continuous disinfection. This may have been due to the high incidence of microorganisms identified in these pens, which probably resulted in a reduced feed intake (see Table 2) and subsequent reduction in mass after 42 days.

The mortality rates throughout the first trial was exceptional high in all the groups of birds, irrespective of the treatment. They were higher than would be expected under normal production conditions and which suggests that the birds were subjected to abnormally high pathogen loads or managemental deficiencies. Although the overall mortality rates were high in all the groups, the mortality rates in the pens which had been subjected to the full continuous disinfection programme were significantly lower than in the pens which had not received this programme. The highest mortality rates occurred in the pens which had been pre-disinfected only. It must be noted that in the pens treated with the full pre-disinfection and full continuous disinfection programmes, the mortality rates were lower than those in the birds in the other two groups (see Table 4 and Fig. 3).

The cause of death could not be determined in a high percentage of the birds submitted for post mortem examination (see Table 4 and Fig. 3). This was due to post mortem decomposition of the mortalities before post mortem examination could be carried out. Only very few of the dead birds collected from the pens of the full continuous disinfection programme were decomposed by the time post mortem examination was performed. This can possibly be explained by the fact that significantly lower numbers of bacteria were recorded in the pens on the full continual disinfection programme (Table 5 and Fig. 4).

When the full continual disinfection programme was tested on a commercial poultry farm under field conditions, it can be seen from the results depicted in Table 6 that until the chickens were 15 days of age, slightly higher mortality rates occurred in house 9 (the control house) when compared to those in the two experimental houses (houses 1 and 6). Slightly better growth rates and feed conversion ratios (data not shown) were also recorded for the chickens in

houses 1 and 6 when compared to those in house 9.

Before the commencement of the ND outbreak, the antibody titre of the birds against ND was determined and it was established that these were very low (data not shown). They were therefore fully susceptible to ND. The reason for the low antibody titres could have been a result of a recent change in the vaccination programme on the farm, where the farmer had switched from a drinking water vaccination system to a spray vaccination system. The very hot and dry location of the farm made the selection of a spray vaccination questionable.

Newcastle disease spread rapidly throughout all 12 houses on the farm. The first report of the disease was on day 14 of the experiment in a house not included in the experiment. On day 15, the mortality rate in the houses included in the experiment was four for house 1, two for house 6 and six for house 9 (see Table 6 and Fig. 5). On day 16, the mortalities in house 9 were 66, and this increased until a maximum of 981 on day 21 was reached (Table 6). On day 27 all surviving chickens in this house were culled.

On day 16, the mortalities in both the experimental houses were low (14 in house 1 and 7 in house 6) (Table 6). The mortalities in these two houses remained at a constantly low level until day 20. In house 1, a spike in mortalities to 14 occurred on day 16. A similar spike of 13 occurred in house 6 on day 17. It is speculated that these spikes in mortalities were the result of the introduction of NDV into the houses as a result of the high levels of mortalities in all of the other houses on the farm. However, on days 18 and 19, the mortalities in both of these houses had returned to normal.

On day 20, the farmer had received the advice from a person not involved in the project to cease the continuous disinfection experiment. This was duly followed on day 20. In house 1, the daily mortalities for days 20 and 21 were 5 and 2, respectively. For the same days, the mortalities in house 9 were 733 and 981, respectively. From day 22, the mortalities in house 1 started to increase until a maximum of 720 mortalities were recorded on day 27. Similar results were experienced in house 6.

CONCLUSION

Under experimental conditions, it can be concluded that the full pre-disinfection programme with a 1 % solution of Virukill, followed by the full continuous disinfection programme, which consisted of the continuous treatment of the drinking water with 100 ppm Virukill and daily (or twice daily up to 2 weeks of age) spraying or fogging of the birds with a 1 % solution of Virukill, did not have any negative effect on production, although higher (but not statistically significant) production parameters were found.

Although the differences in the production parameters were found to be non-significant, it has been demonstrated in this experiment that a full continuous disinfection programme can reduce the mortality rate on a poultry farm. In addition, the full continuous disinfection programme also resulted in a significant reduction in the microbial population in the pens, which could result in better control of infectious diseases.

From the experiment performs under field conditions, it can be concluded that a continuous disinfection programme, consisting of disinfection after cleanout of the poultry houses, continuous treatment of the drinking water and daily spraying of the birds, could limit the spread of ND during an outbreak of ND. At a stage when very high mortalities were recorded in all other houses on the farm in question, including the house selected as a control house for this experiment, mortality rates, which can be regarded as run-of-the-mill, were recorded in the two experimental houses. It can be postulated that the control house and experimental House 1 were infected with NDV on the same day, i.e. day 16. In the control house, the disease spread rapidly resulting in 62 % mortality by day 21. On day 16, there was an increase in the mortality rate in house 1 to 14 mortalities, indicating that houses 1 and 9 were both infected with NDV on day 16. However, the mortality rate from days 16–21 in house 1 was only 0.9 % as compared to 63 % in the control house.

As soon as the continuous disinfection programme was ceased in houses 1 and 6, birds in both of them contracted ND, which resulted in a rapid increase in mortalities.

The concept of using a disinfectant for the continuous disinfection of poultry during broiler production appears to be novel, as there are no reports in the literature where such a full continuous disinfection programme has been used. As such, there are a number of questions that should be addressed before the use of continuous disinfection can be recommended on all poultry production facilities. The most important of these questions is that of safety. From the experiment performed under con-

trolled conditions, there is evidence to suggest that there are no negative effects of a continuous disinfection programme, on the production parameters, as manifested by the fact that there was no significant difference in the growth rates and feed conversion ratio obtained in the birds in the three different treatments. The lower mortality rates obtained under controlled production conditions as well as the apparent ability of the continual disinfection programme to limit the spread of a highly infectious disease, such as Newcastle Disease, suggests that the full continual disinfection programme could greatly assist in the control of infectious diseases in poultry production facilities. From this data it is possible to suggest that this product is both safe and effective for use in broiler production.

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