Studies on Effect of Lighting on "Sudden Death Syndrome" in Broiler Chickens

J. C. ONONIWU, R. G. THOMSON, H. C. CARLSON AND R. J. JULIAN*

SUMMARY

Broiler chicken flocks were studied to determine the mortality from sudden death syndrome occurring in the flocks. The difference in the incidence of the syndrome in pullets and cockerels, and the age at which the most birds are affected were also studied. The weight of sudden death syndrome birds was compared with the flock average and the effect of continuous lighting as opposed to intermittent lighting was examined.

The results suggest that: continuous lighting produces more sudden death syndrome deaths than intermittent lighting; that the incidence of sudden death syndrome is higher in cockerels than pullets; that the highest death rate occurred during the third and fourth weeks of life, and that sudden death syndrome birds on the average were heavier than the flock average.

RÉSUMÉ

Étude de l'effet de la lumière sur le syndrome de mort subite chez le poulet de gril

Cette étude portait sur des troupeaux de poulets de gril. Elle visait à y déterminer la mortalité attribuable au syndrome de mort subite, la différence de l'incidence de ce syndrome, chez les poulettes et les cochets, ainsi que l'âge auquel les poulets sont particulièrement vulnérables. On compara aussi le poids des sujets atteints au poids moyen des autres sujets d'un même troupeau, ainsi que l'effet d'un éclairage continuel par rapport à celui d'un éclairage intermittent.

Les résultats de cette étude révélèrent les faits suivants: un éclairage continuel provoquait plus de cas du syndrome de mort subite qu'un éclairage intermittent; le syndrome affectait plus de cochets que de poulettes; le taux de mortalité le plus élevé survenait chez les oiseaux âgés de trois et quatre semaines; le poids des sujets atteints du syndrome dépassait celui de la moyenne d'un troupeau.

INTRODUCTION

During the past several years, broiler growers in Canada have been experiencing an increased mortality in the latter part of the growing period (2, 3, 4, 11). Some of the increased mortality is due to an acute cardiac arrest syndrome causing sudden death of both cockerels and pullets. The condition has assumed a variety of names including "flip-over", "acute death syndrome", "lung edema", "heart attack", and "sudden death syndrome" (SDS). The syndrome has come into prominence partially as a result of the progress made in the control of other major poultry diseases such as Marek's disease and the respiratory disease complexes.

Fairly accurate mortality figures from SDS have been compiled. Howell (4) estimated that 3% mortality was encountered in a flock that he studied. Brigden and Riddell (2) found that the average mortality due to acute death syndrome reached 1.13% of the flock and was greater than that due to inclusion body hepatitis. These workers suggested that the losses from this syndrome are substantial. In Australia, Jackson *et al* (5) classified SDS among a group they called "died in good condition" which included the following categories: birds that died from suffocation and those with edema and/or congestion of the lungs. These workers found that 15.6% of the total mortality was attributed to this "died in good condition".

The clinical signs described by most authors were those of sudden death of large, well-nourished, rapidly growing, apparently healthy broilers. Cockerels appeared to be more often affected than pullets. Brigden and Riddell (2) found that of those affected, 70% were males and Vock *et al* (12) quoted 80%. According to Julian, 80% of broilers that died of SDS were picked up on their back, 15% on their sides, and 5% on their abdomen (Julian, personal communication, 1970). Brigden and Riddell (2) classified broilers as dying of "acute death syndrome" if they were in good flesh with full gastrointestinal tracts and showed no significant postmortem lesions, except congestion and edema of the lung.

Environmental factors that place broilers under severe stress are expected to decrease efficiency and hence profit. Such factors include noise, social intereaction and stocking density.

Ratcliff and Synder (9) reported on a study of the incidence of myocardial infarction caused by social interaction in male and female chickens caged alone; in male-female pairs; in groups of four males and in heterosexual groups of six, 12 and 24, with a proportion of two males to one female. They suggested that coronary arterial disease which resulted in infarction of myocardium was a response to social interaction, especially interac-

*Department of Pathology, University of Guelph, Guelph, Ontario N1G 2W1 (Ononiwu and Thomson), Veterinary Laboratory, Alberta Department of Agriculture, Airdrie, Alberta T0M 0B0 (Carlson) and Veterinary Services Branch, Ministry of Agriculture and Food, Box 3612, Guelph, Ontario N1H 6R8 (Julian).

tion that related to sexual behavior. Myocardial infarction associated with coronary arterial disease were limited to males of heterosexual pairs that contained 24 chickens. The infarcts were attributed to limited blood flow to the heart muscle due to rapidly developing coronary arterial disease and also to the demand for high levels of myocardial activity. Myocardial infarcts were found in males that died at 16 weeks of age and in females at the ages of 32 and 43 weeks. These findings are irrelevant to SDS in broilers, in terms of the ages of the chickens involved, but cannot be ignored when it is realized that the majority of broilers are grown without separating the sexes, and therefore are subjected to social interactions.

Bolton *et al* (1) studied the effect of stocking density on the performance of broiler chickens. They suggested that at a high population density the risk of disease was high and that there was a possibility that bacterial infection at the clinical and subclinical level retarded growth.

A number of etiological agents have been considered as causing sudden deaths in broilers. Among these were bacteriological infection (2), chlorinated biphenyl (6), selenium deficiency (Julian, personal communication, 1970) and environmental factors.

The purpose of the studies described here was to determine the effect of intermittent as opposed to continuous lighting, on the incidence of SDS in broiler chickens. A pathological study of the process is described in a separate publication (8).

MATERIALS AND METHODS

For the experiments, four pens capable of accommodating about 12,000 broilers each were utilized at a large commercial farm. The broilers were placed at one day of age in two pens managed under continuous lighting or in pens under intermittent lighting. Lighting in all four pens for the first ten days was continuous. From ten days on, one pen from each lighting interval continued on full light until the broilers were marketed at seven weeks of age. The other pens were adjusted for the following seven days to a cycle of three hours full light and one hour darkness. For the next seven days, two hours full light and two hours darkness: for the next seven days, and until the broilers were seven weeks old, one hour full light and three hours darkness. One pen of males and one of females were placed on each of the treatments. All barns were kept under regular surveillance for observation of the clinical signs of broilers dying suddenly. Fresh autopsy materials were also collected for pathological studies. Daily mortality was recorded in each of the pens and SDS victims were identified and recorded on a separate column on the mortality chart.

Since the observations were proportions of original numbers on each experimental treatment, all data of the experiment were subjected to an arc sine transformation before analysis. The transformation was sin $-1p$ where p = the proportion observed in each case. Transformed data are reported on Table II and conclusions drawn from them. Reported means are those of the observed data but all statistical analysis were on the transformed data. Differences between means were tested by the least significant difference methods of 0.01 level of significance (10).

Fifteen carcasses of SDS broilers taken randomly at the ages of two, three and four weeks (total 45) were weighed to establish the average weight of chickens dying acutely for comparison with the flock average weight (established by weekly weighing of 0.5% of the entire flock).

RESULTS

The data of the experiments are reported in Table I. The overall mortality due to SDS was 37% (520) of the total overall mortality in the four barns (1404) for the seven week observation period.

TABLE I
MORTALITY RECORDS IN THE FOUR FLOCKS ON CONTINUOUS AND INTERMITTENT LIGHTING PROGRAMS

	Intermittent		Continuous		
No. of Birds in Each Barn	Females 11,800	Males 11,600	Females 12,000	Males 11,800	Total No. of Birds 47,200
Age in Weeks					
1	[a]61/8 [b]	91/6	90/7	88/15	300/36
2	71/11	99/16	84/12	9/35	333/74
3	41/15	61/34	40/33	98/50	240/132
4	57/18	35/22	44/35	52/50	188/115
5	24/11	30/16	33/14	51/31	138/72
6	21/10	20/10	23/10	26/20	90/50
7	21/8	10/9	23/9	22/15	85/41
Total	296/81	355/113	337/120	416/206	1404/520

[a]Total mortality
[b]Sudden death syndrome

TABLE II
MAIN EFFECT OF LIGHT, SEX, AND AGE TREATMENT ON TOTAL MORTALITY RATES AND MORTALITY DUE TO SUDDEN DEATH SYNDROME OF THE LIGHT EXPERIMENT

Treatment			Mean No. of Mortality	
			Total Mortality	Mortality Due to Sudden Death Syndrome
Light:	Continuous		538	23.3
	Intermittent		46.5	13.9
Sex:	Male		55.1	22.8
	Female		45.2	14.4
Age:	Weeks	1	82.5^{a}	$9.0^{d.f.g}$
		2	83.3^{a}	$18.5^{b.c}$
		3	$60.0^{a.c}$	33.0^{a}
		4	$47.0^{a.c.e}$	29.8^{a}
		5	$34.5^{b.c.e.f}$	18.0^{e}
		6	$22.5^{d.e.f}$	$12.5^{c.e.g}$
		7	$21.5^{d.e.f}$	$10.3^{c.e.g}$
Error		MS	0.0164	0.0018

Error mean square is on arc sin transformed data and has df = 6.
Significantly different at P 0.01 from intermittent and females respectively.
a-g: all means within age treatments having different letters in the same column are significantly different.

Deaths attributed to SDS were 1% of the overall broiler population at the start of the experiment (47,200). The data on Table I were statistically analyzed. Interaction effects between any pair of treatments, light, sex and age were not significant. Therefore, only the main effect means are reported in Table II.

Statistical analysis of the data in Table II on total mortality, showed no difference due to light or sex but difference due to age was significant, such that in week 1 to 3, higher death rates occurred than in weeks 4 to 7.

Continuous lighting gave significantly higher death rates from SDS (P 0.01) than intermittent lighting. Males suffer these deaths faster than females and these deaths are greater in the third and fourth weeks than in the first two and last three weeks of a seven week observation.

Data in Table III shows that there is some difference between average weight of broilers dying of SDS and the flock average weight. The difference in favour of the SDS birds amounted to 2.34% at two weeks, 2.2% at three weeks and 0.79% at four weeks.

DISCUSSION

The process through which light intensity exerts its effect on broiler chickens appears to be unknown. However, North (7) observed that the only reason for an optimum light day in broilers would appear to be to provide sufficient time for the broiler chickens to consume an adequate amount of feed. If the illumination intensity is above the optimum, it would induce cannibalism, excitement, fighting and piling. The effect of these vices when added to environmental stresses on the performance and well being of otherwise healthy broilers is

TABLE III
AVERAGE WEIGHT OF BROILERS DYING OF SUDDEN DEATH SYNDROME COMPARED WITH FLOCK AVERAGE WEIGHT

Age of dead broilers (weeks)	2	3	4
No. of SDS broilers weighed	15	15	15
Difference between average of the flock and SDS broiler			
SDS flock (Average weights/g)	+5.5	+8.7	+4.3
Average weight of broilers dying of SDS (g)	236.8	412.3	612.1
Flock average weight	231.3	403.6	607.8

SDS — Sudden death syndrome

unknown. It would seem logical to conclude that such stresses would adversely affect the more rapid growing birds in a flock.

The observations of flock owners and laboratory diagnosticians that it is the heavier birds in the flock that succumb to SDS is confirmed by the difference in average weight of SDS victims as compared with other flock members in this experiment.

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