AUSTRALIAN EGG®
CORPORATION LIMITED

Studies of cloacal haemorrhage and beak trimming in the laying hen (II)

A report for the Australian Egg Corporation Limited

By Greg Parkinson and Peter Cransberg

September 2003

AECL Publication No 03/22
AECL Project No DAV-188A

ISBN 1 920835 14 8
ISSN 1448-1316

Studies of cloacal haemorrhage and beak trimming in the laying hen (II)
Publication No. 03/22
Project No. DAV-188A

This project was funded under the management of the Rural Industries Research and Development Corporation.

Researcher Contact Details
Dr Greg Parkinson
Victorian Institute of Animal Science
475 Mickleham Rd, Attwood 3049
Phone: (03) 9217 4200
Fax: (03) 9217 4299
Email: greg.parkinson@dpi.vic.gov.au

In submitting this report, the researcher has agreed to AECL publishing this material in its edited form.

AECL Contact Details
Australian Egg Corporation Limited
A.B.N: 6610 2859 585
Suite 502, Level 5
12-14 Ormonde Pde
HURSTVILLE NSW 2220
PO Box 569
HURSTVILLE NSW 1481

Phone: 02 9570 9222
Fax: 02 9570 9763
Email: Irene@aecl.org
Website: http://www.aecl.org

Published in September 2003

Foreword

The research described in this report is a continuation of project DAV-170A, research that was completed at the Victorian Institute of Animal Science (VIAS) in 2001. The primary objectives of the current research initiative are to provide the egg industry with accurate figures regarding the level of mortality caused by egg peritonitis/salpingitis, prolapse and cannibalism; reduce the incidence of cloacal haemorrhage in early lay and any subsequent loss through prolapse and egg peritonitis/salpingitis; initiate research examining the high incidence of egg peritonitis in pullets and layers housed in litter based systems and to develop rearing strategies that reduce the need for beak trimming in pullets and layers housed in controlled environment cages.

Recent experimental models have indicated that cloacal prolapse and vent trauma/picking are likely to be significant causes of mortality in the national commercial flock. Mortality from prolapse and other oviductal pathologies such as egg peritonitis and salpingitis, combined with cannibalism, has been estimated to account for 50% of commercial mortality figures, or 3% of the national flock. These estimates need to be confirmed with a more systematic cross sectional analysis of commercial farms, so that the economic and welfare implications of these losses can be more clearly appreciated by the egg industry.

Previous research (DAV-170A) has shown that a number of birds experience cloacal haemorrhage in early lay, and this can produce chronic damage to the oviduct. More research is required to thoroughly understand the relationships between management and oviductal haemorrhage, and to elucidate the potential role that oviductal haemorrhage may play in the aetiology of prolapse, salpingitis and cannibalism. Additionally, previous "on farm" research has also highlighted the opportunity for the egg industry to reduce the reliance on beak trimming as a routine husbandry practice in circumstances with effective light control.

In an attempt to develop a greater understanding of these issues, a multi-faceted research program was designed that involved some controlled laboratory studies, plus on farm research to assist in refinement of experimental design, and capture the interest of progressive egg producers. To report on these diverse research activities this report has been divided into 4 chapters that report against the initial project objectives. The first chapter reports on an experiment assessing the influence of pullet weight on the incidence of cloacal haemorrhage and production characteristics in laying hens. The second chapter reports on an industry mortality survey encompassing cage, barn laid and free-range layers in Victoria. The third chapter reports on a continuation of research comparing trimmed and non-beak trimmed layers in commercial controlled environment housing. The final chapter reports on a series of experimental flocks in which light intensity and the duration of light intensity during rearing were used to influence the propensity to picking and cannibalism.

This project was funded from industry revenue which is matched by funds provided by the Federal Government.

This report is an addition to AECL's range of research publications and forms part of our R&D program, which aims to support improved efficiency, sustainability, product quality, education and technology transfer in the Australian egg industry.

Most of our publications are available for viewing or downloading through our website:
www.aecl.org

Printed copies can be purchased by faxing or emailing the downloadable order form from the web site or by phoning (02) 9570 9222.

Irene Gorman
R&D Manager
Australian Egg Corporation Limited

Acknowledgments

This project was jointly funded by the Rural Industries Research and Development Corporation and the Department of Primary Industries.

Contents

Foreword iii
Acknowledgments iv
Executive Summary vi

1. The influence of pullet weight on the incidence of cloacal haemorrhage and production characteristics in laying hens
1.1 Introduction 1
1.2 Methods 2
1.3 Results 2
1.4 Discussion 4
1.5 References 5

2. Mortality survey of cage, barn laid and free-range layers in Victoria
2.1 Introduction 7
2.2 Methods 7
2.3 Results 7
2.4 Discussion 9
2.5 References 10

3. Comparison between trimmed and non-beak trimmed layers in controlled environment cage housing
3.1 Introduction 11
3.2 Methods 11
3.3 Results 11
3.4 Discussion 12

4. Observations on flocks of White Leghorns - Interaction between light intensity and cannibalism
4.1 Introduction 13
4.2 Observations 13
4.3 Summary 14
Implications 15
Recommendations 16

Executive Summary

The research presented in this report is a continuation of work initiated at the VIAS addressing the issue of cloacal haemorrhage and cannibalism in the commercial egg industry. The major reason why these issues have been the focus of two research programs is that it is estimated that commercial egg industry mortality of 2-3% is due to the aforementioned causes. The overall aim of this research is to provide a set of practical guidelines for commercial producers to reduce flock mortality by reducing losses due to cannibalism, prolapse and pathologies such as salpingitis/egg peritonitis. The second aim is to reduce the reliance on beak trimming as a management tool for moderating mortality.

The initial interest in this topic was stimulated by evidence indicating that light birds appeared to be more affected by pathologies associated with cloacal haemorrhage. Furthermore, laboratory models indicated that oviduct haemorrhage and/or picking behaviours in commercial layers was not uniformly distributed across the life of the laying flock. These problems were accentuated at stages corresponding to periods of high metabolic pressure (peak production and peak egg mass). It was also apparent that cloacal haemorrhage was occurring independent of picking behaviour. The important questions that needed to be resolved were; what factors are responsible for cloacal haemorrhage in early egg production, does the tissue damage produce oviduct dysfunction and/or infection, and is there a relationship between picking/cannibalism behaviours and cloacal haemorrhage.

One of the aims of the research in the current report was to provide evidence that supported the hypothesis that of commercial egg industries total mortality 2-3% was caused by cannibalism or oviduct dysfunction. To this extent a mortality survey was carried out in the commercial egg industry, a survey which collected 871 dead birds from 6 different farms (4 cage, 1 barn and 1 free-range farm). Post mortems were carried out on each bird by experienced pathologists and indicated that 47% of the birds had died from cannibalism or complications of cloacal haemorrhage. If we assume that the average mortality in the commercial egg industry is approximately 6% then approximately 2.8% can be attributed to cannibalism and oviduct dysfunctions. Clearly these pathologies are very significant sources of mortality in laying birds in commercial conditions.

Studies on the incidence of cloacal haemorrhage in birds with significantly different bodyweights, indicated that low body weights at 18 weeks was associated with a reduction in total production to 36 weeks, and a significant increase in the number of birds with cloacal haemorrhage. It seems reasonable therefore to hypothesise that the increased incidence of cloacal haemorrhage in under weight flocks or flocks with a large proportion of under weight birds, could be a critical factor in determining flock mortality. The studies to date however have indicated that salpingitis/egg peritonitis is unlikely to occur in single bird cages despite the presence of relatively severe cloacal haemorrhage. These findings are consistent with other Australian research using large numbers of birds in single bird cages that have clearly associated salpingitis/egg peritonitis with multiple bird cages. Furthermore, prolapse of the oviduct has not been able to be induced, even in significantly under weight birds in single bird-cages. Spontaneous oviduct prolapse is widely believed to occur in commercial layers, and it may be that the models of low body weight utilised in this research are not able to reproduce all the factors implicated in prolapse. More research using single bird cages with abnormal bird weights and egg weights may be justified.

The other exciting possibility arising from this project is the opportunity to markedly influence a bird's propensity for cannibalism. The studies conducted illustrate a capacity to almost completely eliminate feather picking from pullets by a program of low light intensities in the rearing phase which has significant carry over effects into egg production in controlling cannibalism. Craig and Muir (1993) showed that the incidence of picking has a low heritability and therefore there must be large environmental and/or management factors that exacerbate the problems in commercial flocks. Some commercial farms in Victoria using brown egg layers without beak trimming have been able to achieve mortality figures at breed standards, and in line with other producers using beak trimming. The hypothesised explanation for the successful management of these non-beak trimmed flocks has been light control during the rearing process, to prevent or inhibit the development of feather picking and cannibalism behaviours. To assess this hypothesis a farm with light control agreed to maintain a small percentage of a flock untrimmed and rear them under defined low light intensity conditions. Mortality patterns to 55 weeks of age have been very low in the flock (3.2%) in sheds with a light intensity of 15 to 30 lux. There was no significant difference in mortality or production between the beak trimmed and non-beak trimmed flocks, although feather cover in the non-trimmed birds may have deteriorated when using these moderate light intensities.

Experimental models using White Leghorns at the VIAS have also clearly illustrated a very significant impact of light control in imprinting a low propensity for cannibalism, and large negative long-term consequences of stimulating feather picking in young pullets.

In the future, a combination of light management of pullets, improved flock uniformities with control over onset of sexual maturity, and uniform layer shed light intensities of 5-10 lux will significantly lower flock mortalities. Successful application of these approaches will inevitably facilitate the elimination of beak trimming as a routine husbandry practice in sophisticated shedding. At this stage the imprinting of a low propensity for picking in pullets with low light intensity rearing appears to provide the most significant control over cannibalism. The more subtle effects of cloacal haemorrhage and layer house light intensities, are also likely to be significant additive components in the aetiology of cannibalism, prolapse and salpingitis, and should not be underestimated.

1. The influence of pullet weight on the incidence of cloacal haemorrhage and production characteristics in laying hens

1.1 Introduction

Recent experimental models have indicated that cloacal prolapse and vent trauma/picking are significant causes of mortality in the national commercial flock. Mortality from prolapse and other potential complications of oviduct haemorrhage such as salpingitis and egg peritonitis, combined with cannibalism, is estimated to be 2-3%. The severe nature of the injuries and tissue damage that results from prolapse or cannibalism is a vexing welfare issue for the industry. These prolapse and picking problems have a low heritability and there must be large environmental/management factors which exacerbate the problems in commercial flocks.

Initial observations and experiments have indicated that growth rate in early lay appears to be critically important in determining the extent of the cloacal haemorrhage problems and associated pathologies. For example, in a single bird study recently completed at the VIAS, a comparison between those birds that produced a blood stained egg (an indicator of cloacal haemorrhage) against those birds that did not, indicated that birds producing a blood stained egg were approximately 50 grams lighter throughout the experimental period.

The level of blood stained eggs in a flock may be a significant indicator of the health and mortality of the flock, because the associated cloacal or oviduct haemorrhage may be linked to prolapse, salpingitis/egg peritonitis, and cannibalism. In cage systems, it is difficult to determine what proportion of cloacal or oviduct haemorrhage is due to picking behaviour and cannibalism, and what proportion is due to uncomplicated oviductal/cloacal dysfunction. Uncomplicated oviduct haemorrhage or prolapse has been described in commercial laying birds, but a lack of objective data on its incidence and interactions with management may have resulted in a tendency to attribute many of these problems to cannibalism.

Limited evidence is available in the literature assessing the relationship between body weight at point of lay and subsequent production in commercial laying hens. In the research available the range of body weights studied have generally been close to or above recommended breed standards and there has been no significant correlation between body weight and production (Balnave, 1984; Harms *et al*, 1982; Leeson and Summers, 1987). Very little research has examined the thresholds of body weight below which productivity may be compromised. Evidence from studies of Australian commercial laying flocks suggests that there is an important link between point of lay body weight and subsequent production and also a significant link between growth rate in early lay and production.

The experiment described in this chapter compares the performance of brown egg layer pullets of markedly differing body weights. Birds were selected at 16 weeks of age on the basis that they were either greater than 5% below the breed standard or alternatively they were greater than 10% above the breed standard. All birds were housed in single bird cages to remove the possibility of confounding the experiment with picking or cannibalism behaviours. The birds were monitored for body weight, egg weight, egg production, feed intake and blood stained eggs (an indicator of cloacal haemorrhage) from 16 to 36 weeks of age.

1.2 Methods

At 16 weeks of age 48 Lohmann Brown pullets were selected from a commercial layer farm on the basis of body weight. The birds were individually weighed and divided into two groups, light and heavy. The light (L) group contained birds weighing less than 1.27kg and the heavy (H) group consisted of birds weighing more than 1.50kg (breed standard is 1.33kg (Lohmann Tierzucht, 2001)). The birds were then transferred to an experimental facility where they were randomly allocated to single-bird cages in a temperature-controlled shed, under 16 hours of light. Food and water were provided *ad libitum*.

The pullets were fed a commercial diet containing 17% protein, 2800kcal/kg metabolisable energy and 3.7% calcium. Production and the incidence of blood stained eggs were recorded daily. Body weights and egg weights were recorded weekly, and daily feed intake from 18-36 weeks of age was calculated. Birds producing severely blood stained eggs were examined for signs of cloacal haemorrhage by eversion of the cloacal tissue.

1.2.1 Statistical Analysis

Analysis of variance was used to determine if there was a significant difference between the average bodyweights of the two groups (L and H) at 36 weeks of age. Analysis of variance was also used to determine whether production and average egg weight differed significantly between the groups.

Linear regression analyses were used to determine the significant strength of the associations between total egg production, blood stained egg production, body weights at 18 and 36 weeks of age and weight gain between 18 and 36 weeks of age. The analyses of variance and regression analyses were completed using GenStat Release 6.1, Laures Agricultural Trust (Rothamsted Experimental Station).

1.3 Results

1.3.1 Body weight

Mean body weight of the light group at 36 weeks of age (1.65 kg) was significantly less than the heavy group (2.02 kg) ($p<0.01$). The bodyweight patterns of the two groups are shown in Figure 1. Body weight at 18 weeks and body weight at 36 weeks were strongly correlated ($r=0.811$; $p<0.001$).

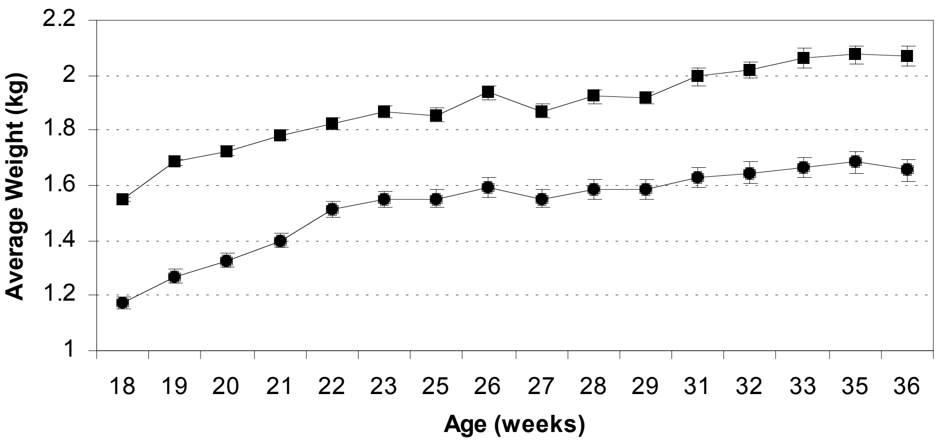

Figure 1. Body weight patterns of light (●) and heavy birds (■) from 18 to 36 weeks of age. Error bars are SEM's.

1.3.2 Production

The heavy group had a significantly higher average total production to 36 weeks compared with the light group ($p<0.05$) (Figure 2). The heavy group produced approximately 15 more eggs/bird (112 versus 97) in the period between 18-36 weeks of age.

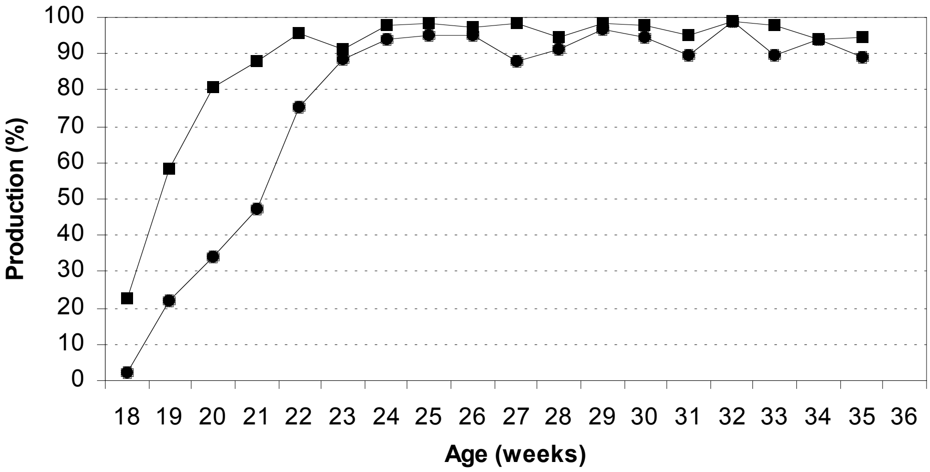

Figure 2. Comparison of production between the light (●) and heavy (■) groups to 35 weeks of age

1.3.3 Feed Consumption

Feed consumption was significantly different between the two groups. Average feed intake from 18 to 36 weeks was 95 grams per bird per day in the light group compared with 113 grams per bird per day in the heavy group ($p<0.05$).

1.3.4 Number of birds laying blood stained eggs

The number of birds to lay one or more blood stained eggs was higher in the light group (9 birds) compared with the heavy group (3 birds).

Two of the under weight birds from a population of 24 birds in the light group produced several eggs with moderate surface blood staining that covered approximately 30-40% of the egg shell surface. Inversion of the cloaca was able to clearly identify areas of haemorrhage in the cloacal tissue. All of the blood stained eggs from the heavy group had only slight blood staining.

1.3.5 Egg weight

The average egg weight of both the groups was not significantly different over the experimental period however there was a trend that the heavier birds produced heavier eggs than the light group (Figure 3). It should be noted that the average egg weight of both these groups was significantly lower than the breed standard. The breed standard indicates an egg weight of just over 63 grams at 36 weeks whereas the birds in this trial had an egg weight of approximately 56 grams.

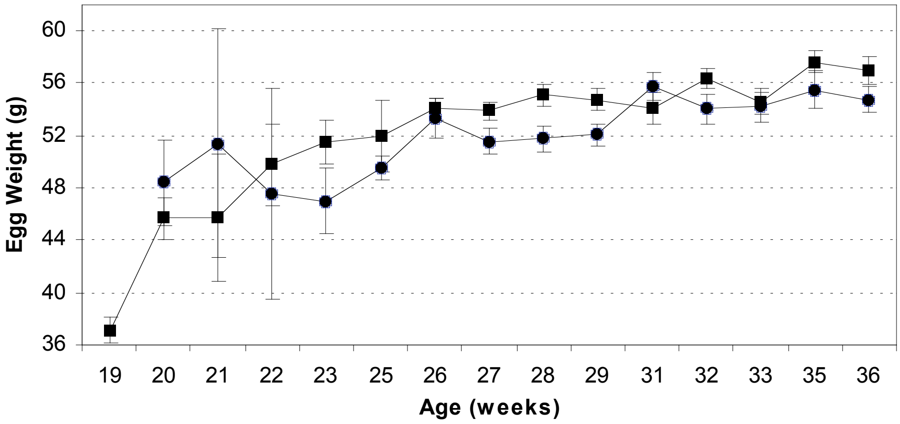

Figure 3. Egg weight comparison between the light (●) and heavy (■) birds to 36 weeks. Error bars are SEM's.

1.3.6 Relationship between body weight, body weight changes and production

Total egg production between 18 and 36 weeks of age was moderately positively correlated with body weight at 18 weeks of age ($r=0.5805$; $p<0.001$). Total production was also moderately correlated with weight gained, between 18 and 36 weeks of age ($r=0.6356$; $p<0.001$).

The correlated explanatory variables, initial weight at 18 weeks and weight gain from 18 to 36 weeks ($r=0$; $p<0.687$), both significantly affected total egg production ($p<0.05$; multiple $r=0.64$). Production increased with increasing initial weight and decreased with increasing weight gain.

1.3.7 Mortality

Two birds were culled between 18-20 weeks of age due to Marek's disease, and a third bird was culled at 26 weeks of age due to a tumour on its right leg. All of these birds were from the light group.

1.4 Discussion

Initial weight at 18 weeks of age accounted for 66% of the variation in bodyweight at 36 weeks of age, which is similar to the findings of Balnave (1984). The present study shows that the relationship between body weight at 18 weeks and body weight at 36 weeks applies over a broad range of initial body weights, and in birds housed in single-bird cages without social competition. Our study supports the findings of Harms *et al* (1982), Balnave (1984), and Leeson and Summers (1987) that body weight differentials are maintained throughout the laying period.

Body weight at 18 weeks of age accounted for 31% of the variation in total production. Initial weight at 18 weeks of age ($p<0.005$) and weight gained between 18 and 36 weeks of age ($p<0.001$) explained 42% of the variation in total production between 18 and 36 weeks of age. Body weight at 18 weeks of age is, therefore, an important factor in determining total production between 18 and 36 weeks.

The heavy group produced significantly more eggs between 18 and 36 weeks of age compared with the light group. In contrast, Harms *et al* (1982) and Balnave (1984) found that pullet body weight did not significantly influence production. This difference may be a reflection of the low average body weight of the light group (1.18 kg at 18 weeks of age) used in our experiment. Leeson and Summers (1987) also found that low body weight in 18 week old White Leghorns also reduced egg production between 19-25 weeks by approximately 5%. Interestingly, there was a significant negative correlation between egg production and weight gain between 18 and 36 weeks of age. It is possible that birds with higher production tend to gain less weight because they invest a larger proportion of the energy consumed into egg production, rather than into growth.

The light group had body weights 5-30% below breed body weight standards at 18 weeks. At 36 weeks of age the majority of these birds were between 10-30% below breed standards, however, two of the birds exceeded the breed standard weight. There was a clear increase in predisposition to cloacal haemorrhage in the light group, as illustrated by the increased number of birds producing blood stained eggs. Forty percent of the light group produced at least one blood stained egg whereas only 10% of the heavy group produced a blood stained egg. Despite obvious damage to the oviduct, as indicated by the number of blood stained eggs, the high incidence of cloacal haemorrhage in the light group was not associated with any prolapse, salpingitis or mortality. The body weights of the light body weight group (1.65 kg) at 35 weeks of age seem likely to be representative of the smallest population of birds in cage production systems, but could underestimate the range of light birds in many of the barn or floor based flocks. Similarly to the current experiment, observations of several barn egg production units have identified that under weight flocks have lower peak production, poorer persistency of production, abnormally high levels of blood stained eggs, and higher mortalities due to egg peritonitis/salpingitis and cannibalism. Higher dietary nutrient densities and heavier pullet weights have been adopted to improve body weight in these floor systems, and this has been associated with improved hen housed egg production, and moderation of overall mortality, presumably because of the elimination of under weight birds.

The egg:body weight ratio at 36 weeks of age was significantly larger in the light group when compared with the heavy group. This finding suggests that low body weight increases egg:body weight ratio, despite a decrease in egg weight. Egg:body weight ratio did not significantly influence the total number of blood stained eggs laid between 18 and 36 weeks of age. However, the average egg size at 36 weeks of age was quite low in both groups, egg weight for the heavy group was 3-4 grams below the breed standard and egg weight for the light group was 6-8 grams below the breed standard (Lohmann Tierzucht, 2001). If there is a mechanical relationship between egg size and the incidence of cloacal haemorrhage, as indicated in previous work conducted at the VIAS, then additional experimentation may be required to examine the interactive effects of low body weights with a larger range of average egg weights.

In individual birds the cloacal haemorrhage can become sufficiently severe to ensure that the lesion is visually obvious upon eversion of the cloaca. In these circumstances the tissue haemorrhage is also likely to be visible to other birds during egg expulsion. At this stage, none of the experimental models using brown egg layers in single bird cages (approximately 200 birds), have been able to reproduce prolapse of the oviduct, nor has salpingitis/egg peritonitis been observed. These observations support the hypothesis that salpingitis/egg peritonitis is dependent on the presence of cage mates (Cumming, 2001).

Overall, our findings suggest that low body weights at 18 weeks is associated with a reduction in total production to 36 weeks and a significant increase in the number of birds laying blood stained eggs. The significance of cloacal haemorrhage to problems such as cannibalism and egg peritonitis/salpingitis remains to be determined. However, it seems likely that the increased incidence of cloacal haemorrhage in under weight flocks or flocks with a large proportion of under weight birds, would be a critical factor(s) in determining flock mortality by predisposing birds to vent trauma.

Additional research with different ratio's of early egg weight to low body weights may be worthwhile in attempts to provide more objective information on prolapse and it may be necessary to undertake experiments with severe cloacal haemorrhage with cage mates to reproduce salpingitis/egg peritonitis.

1.5 References

Balnave D. 1984. The influence of body weight at point-at-lay on the production responses of restricted-reared pullets. Aust. J. Agric. Res., 35, 845-849

Cumming, R.B. 2001. The aetiology and importance of salpingitis in laying hens. Proc. Aust. Poult. Sci. Symp. 14: 194-196.

Harms R. H., P.T. Costa, and R.D. Miles. 1982. Daily feed intake and performance of laying hens grouped according to their body weight. Poult. Sci., 61, 1021-1024.

Leeson S., and J.D. Summers.1987. Effect of immature body weights on laying performance. Poult. Sci., 66, 1924-1928.

Lohmann Tierzucht. 2001. Layer Management Program. Lohmann Brown. Lohmann Tierzucht GMBH, Germany.

2. Mortality survey of cage, barn laid and free-range layers in Victoria

2.1 Introduction

Very few studies have been published that examine the causes of mortality in layer flocks under Australian conditions. Based on experimental models and farm observations the authors have estimated that mortality from prolapse, egg peritonitis and salpingitis, combined with cannibalism, is 2-3% in the commercial egg industry from a total annual mortality of 6%. The aim of this component of the research program was to conduct a cross sectional survey across a number of commercial farms, examining the causes of mortality in cage, barn and free-range enterprises to validate the initial estimate.

2.2 Methods

Four cage, 1 barn and 1 free-range farm were selected to participate in the study. Three of the four cage farms housed birds in multi tiered controlled environment shedding, while the fourth was a single tiered, naturally ventilated, curtain sided shed. A visit to each farm was made at least weekly and dead birds (including culls) were collected, in the majority of cases, from that day only. In circumstances where the producer was able to refrigerate the dead birds then producers would store birds until the collection day. The birds were then taken to the Victorian Institute of Animal Science where a gross post mortem was carried out by experienced pathologists. In the situation where a number of pathologies existed, a judgement was made by the pathologist on the main cause of death.

2.3 Results

2.3.1 Cage Birds

Six hundred and fifty one birds were post mortemed from cage farms. Birds ranged from 18-54 weeks of age. Two hundred and sixty two of the 651 birds sampled were diagnosed as having died due to prolapse, egg peritonitis, salpingitis and cannibalism (Table 1) which is just over 40% of the total number of birds sampled. One hundred and eight birds died of unknown reasons (Table 1).

Table 1: Post mortem results on cage birds

	Age (weeks)						
Main Diagnosis	18-24	25-30	31-36	37-42	43-48	49-54	***Total***
Salpingitis/peritonitis	46	33	13	9	8	1	***110***
Egg bound	11	10	1	1	1	1	***25***
Prolapse	14	18	4	3	7	8	***54***
Cannibalism	14	23	14	12	2	8	***73***
Gout	12	31	5	4	2	1	***55***
Mareks	25	31	4	2	3	4	***69***
Other trauma*	10	10	3	2			***25***
Pericarditis	1	3			3		***7***
Fatty liver / Hepatic necrosis	5	9	3	3	5	1	***26***
Osteoporosis	4	12	10	1	5	2	***34***
Emaciation	22	7	4	2	8	9	***52***
Other	2	8	3				***13***
Unknown	35	26	18	11	11	7	***108***
Total	201	221	82	50	55	42	***651***

*** Injuries such as broken legs or wings, getting caught in equipment**

2.3.2 Barn-Laid Birds

Fifty-seven birds were post mortemed from one barn farm. Birds ranged from 18-26 weeks of age. Forty seven of the 57 birds sampled were diagnosed as having died due to prolapse, egg peritonitis, salpingitis and cannibalism (Table 2) which is just over 82% of the total number of birds sampled.

Table 2: Post mortem results on barn birds

	Age (weeks)		
Main Diagnosis	18-22	23-26	***Total***
Salpingitis / peritonitis		21	***21***
Prolapse		3	***3***
Cannibalism	23		***23***
Mareks	4	2	***6***
Other		3	***3***
Unknown		1	***1***
Total			***57***

2.3.3 Free-range birds

One hundred and sixty three birds were post mortemed from 1 free-range farm. Birds ranged from 25-53 weeks of age. One hundred and one of the 157 birds sampled were diagnosed as having died due to prolapse, egg peritonitis, salpingitis and cannibalism (Table 3) which is just over 64% of the total number of birds sampled.

Table 3: Post mortem results on free-range birds

Age (weeks)

Main Diagnosis	25-30	31-36	37-42	43-48	49-53	***Total***
Salpingitis / peritonitis	7	2	10	6	13	***38***
Egg bound	1				1	***2***
Prolapse		1		5		***6***
Cannibalism	11	13	21	7	3	***55***
Mareks	1			3		***4***
Other trauma*	3		1	1		***5***
Osteoporosis				4		***4***
Emaciation	3	3	4	4		***14***
Other	3		3	2	2	***10***
Unknown	10	1	3	9	2	***25***
Total						***163***

2.4 Discussion

The mortality survey of 871 laying hens from 6 farms indicates that oviduct dysfunction and cannibalism account for approximately 47% of total mortality. Salpingitis/egg peritonitis and cannibalism are very significant causes of mortality, irrespective of the egg production system.

Average flock mortality in the Australian egg industry is currently estimated at 6%. Based on this mortality survey 2.8% of total mortality would therefore be accounted for by oviduct dysfunction and cannibalism. The limited sample of free-range and barn flocks indicates that the percentage of mortality caused by these pathologies may be increased to between 64 to 82% of total mortality respectively. The impact of these factors on the commercial egg industry is extremely significant.

Research by Craig and Muir (1993) has shown that the incidence of cannibalism has a low heritability, and work at the VIAS has indicated the incidence of cannibalism is very responsive to management. A precise aetiology of salpingitis/egg peritonitis is unclear at this stage, but may be dependent on the presence of cage mates, since a long term research program indicated that salpingitis/egg peritonitis was not been observed in some 12,500 birds housed in single bird cages (Cumming, 2001).

The other significant finding was the high incidence of mortality of unknown aetiology (approximately 15%) and the numbers of emaciated birds (approximately 8%) in the mortality study. Gregory and Devine (1999) observed significant levels of flock emaciation in end of lay hens (3-20%), and these findings seem likely to have important ramifications from both a production and welfare standpoint. The detection of significant numbers of emaciated dead birds in this study may be indicative of a larger overall problem. That is there may be a number of birds in a flock that are underweight, and thus reducing the level of production, but not actually dying.

2.5 References

Craig, J.V. & Muir, W.M., 1993. Selection for reduction of beak-inflicted injuries among caged hens. *Poultry Science*, **72:** 411-420.

Cumming, R.B. 2001. The aetiology and importance of salpingitis in laying hens. Proc. Aust. Poult. Sci. Symp. 14: 194-196

Gregory, N.G. and Devine, C.D., 1999. Body condition in end-of-lay hens: Some implications. Veterinary Record, 145: 49.

3. Comparison between trimmed and non-beak trimmed layers in controlled environment cage housing

3.1 Introduction

One of the practical objectives of this research program was to continue to develop rearing strategies that will reduce the reliance on beak trimming as a means of preventing cannibalism in pullets and layers housed in controlled environment cages. As stated previously one of the major egg producers in Victoria has not beak trimmed their birds for many years, and has never experienced significant picking problems. The most obvious difference between this commercial farm and other farms is that during the rearing phase (5-16 weeks) the birds are kept in a controlled environment shed where the light intensity is kept between 2-5 lux. It has been hypothesised that the primary factor behind the lack of picking behaviour is this low light intensity during rearing. It is believed that the use of low light intensities at ages normally associated with feather picking acts to suppress the picking behaviour. Furthermore it is hypothesised that the suppression of picking during rearing produces persistent effects in the laying phase.

As a continuation of work started in project (DAV-170A) it is important to continue trialing the use of low light intensity rearing and no beak trimming on a number of different commercial farms with controlled environment rearing, if there is going to be widespread acceptance within the commercial sector. The aim of this trial was to compare production, picking behaviour and mortality during the laying cycle in trimmed and non-beak trimmed birds in a commercial controlled environment shed after rearing in low light conditions.

3.2 Methods

A flock of 26,000 birds was reared in a low light intensity (~5 lux) cage rearing shed from 4-16 weeks of age. At 11 weeks of age 25,500 birds were beak trimmed, as per normal farm management, whilst the remaining 500 remained untrimmed. Both trimmed and non-trimmed birds were housed in the same controlled environment shed and randomised within the house at the convenience of the cooperating producer. All birds were housed in cage groups of 5 birds and distributed from the top to the bottom tiers of cages in a 5 tier cage bank.

Throughout the shed, light intensity varied from 30 lux at the top tier to 7 lux at the bottom tier and the untrimmed birds were housed in a block close to the exhaust fans. The light intensity to which the untrimmed birds were exposed exceeded the whole shed average by an estimated 10 lux, and fluctuated with daylight intensities.

3.3 Results

3.3.1 Production and body weight

There was no difference in egg production between the trimmed and untrimmed birds recorded at 32 weeks of age and hen day production was 93.4% at 32 weeks. The average body weight of the untrimmed birds was 40 grams heavier than the trimmed birds (1.93 verses 1.89 kg) at 33 weeks of age, but the difference was not significant.

At 55 weeks of age the total flock was producing at 88% with a total mortality of 3.23% from 18-55 weeks of age.

3.3.2 Picking behaviour

The untrimmed birds had a reduced feather covering than those birds that had been beak trimmed. This was not cannibalism and would be more correctly described as feather pulling. Observations by the experimenters indicated that there were no lesions on those birds with reduced feather cover, simply a reduction in the number of feathers.

3.3.3 Mortality

There was no difference in mortality between the trimmed and untrimmed birds to 32-33 weeks of age. The untrimmed birds averaged 0.85% and the whole shed had recorded a total mortality of 1.25% between 16 and 33 weeks of age.

No significant differences in mortality were observed between the trimmed and untrimmed groups and the mortality of the whole shed was approaching world's best practice of 3.23%.

3.4 Discussion

As has been seen in previous experimentation there was no difference in either productivity or mortality between the trimmed and untrimmed birds. The slight loss of feather cover is an aesthetic disadvantage and it may be argued that this will increase the feed intake of the birds to maintain body temperature. It is unlikely however, in a controlled environment shed, that the feed intake would increase sufficiently to have an economic impact on the producer. The accelerated loss of feather cover in the untrimmed birds may contribute to skin abrasion and could result in increased mortality as the flock ages. These hypotheses need to be evaluated to provide quantitative evidence of a link between feather loss and mortality.

The possibility also remains that the combination of low light intensity rearing (~5 lux) combined with higher light intensity in the laying phase (7-30 lux) may be influencing the extent of the feather picking. The maintenance of a more constant light intensity between the rearing and laying phases could have significant benefits in moderating bird behaviour and ameliorating some of the feather loss.

4. Observations on flocks of White Leghorns - Interaction between light intensity and cannibalism

4.1 Introduction

During the 2 years of this research program, other research carried out at the VIAS has contributed to our knowledge of the interaction between light intensity and cannibalism. The findings reported in this chapter are observations arising from genetic comparisons made between different White Leghorn lines reared and housed in the similar environments.

4.2 Observations

4.2.1 Experimental White Leghorn flock 1: Early feather picking and cannibalism

During 2001 the poultry group at VIAS was involved in the management of experimental lines of White Leghorns. Fertile eggs from two lines of White Leghorns (A) and (B) where hatched together and the chicks placed into group pens housing approximately 50 birds per pen. The lights were initially on 24 hours per day at approximately 200 lux to ensure that the birds found water and feed after hatching. After 2 days the light was reduced to 12 hours per day at a similar light intensity. After 5 days the chicks from line (A) had begun to cannibalise each other, which resulted in an increase in mortality. The birds from line (B) were unaffected by the cannibalism problems. The lights were immediately dimmed to approximately 20 lux and all birds of both lines were beak trimmed. This had the effect of reducing the cannibalistic behaviours in line (A) for approximately 3 weeks, but the birds again initiated picking behaviours at about 4-5 weeks of age, despite the lower light intensities.

As a consequence of the ongoing cannibalism, the lights were dimmed to the minimum level possible (approximately 5 lux) and the birds were again beak trimmed. Cannibalism behaviours were again reduced, but persisted intermittently in line (A) throughout the rearing and egg laying phase. In the same environment no cannibalism was manifested in the line (B) birds between day old to 12 weeks of age (Line B birds were no longer maintained after 12 weeks of age).

The line (A) birds were extremely sensitive to light intensity throughout their life span and outbreaks of cannibalism could be triggered in individual cages/pens with inadvertent increases in light intensity triggered by shed management. The White Leghorn line (A) seemed particularly susceptible to high early light intensities (0-2 weeks of age) which triggered wide spread feather picking and cannibalism, and these behaviours became resistant to conventional management strategies such as beak trimming and low light intensities.

4.2.2 Experimental White Leghorn flock 2: Juvenile feather picking and correlation with cannibalism

Three lines of experimental White Leghorn layers (C, D and E) were reared in controlled environment shedding on conventional commercial stockfeed. Line C was the offspring of line A while line D was a cross between the female of line A and the male of line E. All birds were lightly beak trimmed at day old. Lights were maintained at 50 lux for 24 hours for the first two days and then reduced to approximately 5 lux. However during the second and fourth week the lights were inadvertently left on, increasing light intensity to 50-60 lux for a period of approximately 12 hours. Immediately following the increase in light intensity lines (C) and (D) initiated severe feather picking and cannibalism. In the same environment line (E) did not manifest picking behaviours. At 6 weeks of age all three strains were again mildly beak trimmed. At 12 weeks of age all birds were moved into a 3 tiered controlled environment laying house.

Lines (C) and (D) continued to pick intermittently throughout the rearing and laying cycle especially if they were exposed to even short duration's of increased light intensity (10 to 50 lux). On occasions where the managers were required to work in the shed for extended periods and were moving in and out of the building regularly (and thus exposing the birds to light through the door), picking behaviour became more pronounced. Line (E) has not exhibited any picking or cannibalism behaviours to 45 weeks of age, and appears to have a lower propensity for cannibalism.

Table 1. Mortality and culls due to cannibalism and proportion of flock picked in lines C, D and E between day old and 16 weeks of age. Mortality and culls due to cannibalism in lines C, D and E between 16-40 weeks of age

Line	Mortality (%)	Picked (%)
0-16 weeks		
C	2.5	6.3
D	2.9	5.8
E	0	0
16-40 weeks		
C	5	
D	8	
E	0	

The majority of the mortality and birds culled for cannibalism were recorded in the top tier of the three tiers of laying cages, and these findings are consistent with previous observations from two other commercial egg producers.

4.2.3 White Leghorn flock 3: Control of juvenile feather picking and cannibalism

Another hatch of the same three layer lines (C, D, E) were reared in very similar conditions to White Leghorn flock 2 in the same cages and were fed a similar diet. The only difference was complete control of light intensity during the rearing period. From 2 days of age, light intensity was maintained at approximately 5 lux until 16 weeks of age. At 10 weeks of age these birds were mildly beak trimmed and transferred to laying cages at 15 weeks of age where light intensity has been maintained at 5 lux. These birds are currently 33 weeks of age and there has been no feather picking or cannibalism behaviours observed throughout the rearing and laying phases. Mortality due to cannibalism has been zero for all three strains.

4.3 Summary

These studies show the acute effects of light intensity on the onset of feather picking, and the likely long term effects of the development of feather picking behaviours on cannibalism and mortality. Strains predisposed to cannibalism need precise management from very early ages, but it appears possible to have complete control of cannibalism by behavioural imprinting and the use of low light intensities during egg production.

In flocks in which feather picking and cannibalism behaviours have been imprinted even short term exposure to high light intensities can trigger reversion to cannibalism.

In contrast to findings presented by Craig and Muir (1993) it appears that the propensity to cannibalise in the White Leghorn strains discussed in this chapter was highly heritable. Strain A birds and the offspring of those birds (lines C and D) were extremely sensitive to increases in light intensity and need to be managed accordingly. No evidence of cannibalism was been experienced in any of the Line E birds to 45 weeks of age, or the parents of those birds.

Implications

1. Salpingitis/egg peritonitis and cannibalism are very significant causes of mortality in the modern brown egg layers in Australia.
2. Light intensity can have profound effects on cannibalism behaviours in predisposed strains with both acute and more chronic imprinted effects.
3. Significant genotype by light intensity interactions may occur which could have large impacts on mortality due to cannibalism.
4. The models utilised in this research indicate that predisposition to cannibalism can be controlled with imprinting of behaviour patterns in the rearing phase.
5. At this stage, imprinting of resistance to cannibalism behaviours seems to be more significant than problems of cloacal haemorrhage in the induction of severe cannibalism.
6. The interaction of under weight birds with significantly increased cloacal haemorrhage, and flock behaviour needs more study in predisposed strains.
7. In the experimental models the majority of the mortality was recorded in the top tier of cages between the ages of 18-40 weeks of age, presumably due to the higher light intensities.
8. Almost complete control over cannibalism can be achieved by low light intensity rearing (~5 lux), but these low light intensities may have managerial and aesthetic disadvantages.
9. It seems clear that multiple beak trimming and low light intensities cannot override aberrant picking behaviour patterns that have developed in pullets.
10. The elimination of beak trimming seems likely to be able to be achieved in brown egg layers housed in shedding with light control without significant impacts on mortality.
11. The elimination of beak trimming from brown egg layer flocks may result in increased feather loss, but this may also interact with shed light intensities.
12. A combination of behavioural modification of layer pullets together with elimination of under weight birds has the potential to markedly reduce losses through cannibalism and perhaps control salpingitis/egg peritonitis provided that vent picking is the primary reason for the induction of salpingitis/egg peritonitis.
13. The mortality survey also indicates that emaciation remains a significant problem, and a large proportion of mortality has an unknown aetiology.

Recommendations

- Studies of strains with both high and low propensity to cannibalism should be undertaken with slightly higher rearing light intensities (5-10 lux) that are more amenable to management within sheds.
- Examine opportunities to utilise light of different wavelengths to moderate mortality due to cannibalism.
- Studies should be undertaken to examine the different combinations of shed light intensities used in both the rearing and laying phases throughout the industry and the accompanying rates of mortality and feather cover.
- Establish studies that continue to examine the link between cloacal haemorrhage with prolapse in single bird-cages using different ranges of body weight and egg weight.
- Establish additional experimental models that study the link between cloacal haemorrhage, with the induction of egg peritonitis/salpingitis in multiple bird cages.
- Undertake studies within the commercial industry of flock body weight distributions in controlled environment housing to establish best practice bench marks for body weight distributions, production and mortality.
- Undertake studies within the industry of flock body weight distributions in barn egg production systems to establish best practice bench marks for body weight distributions, production and mortality