Effect of Claw Abrasives in Cages on Claw Condition, Feather Cover and Mortality of Laying Hens

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ABSTRACT : A trial was conducted to determine the effect of abrasive strips and abrasive paint in layer cages on claw length and claw sharpness, foot condition, feather cover and mortality of hens. During the preparation of the cages for the experiment it was simpler and took less time to apply the pre-prepared paint with a spatula to the egg guard compared to sticking the abrasive strips onto the egg guard. Fitting the strips took longer because it had to be cut from a 25 mm roll, cut into the appropriate lengths, the tape backing removed and then stuck onto the egg guard section. Abrasive paint was more effective as a claw shortener than abrasive strips. The birds using the abrasive paint had the shortest ($p<0.05$) claw length and lowest ($p<0.05$) claw sharpness. One of the original reasons for reducing claw length with claw shorteners was to reduce mortality by minimising skin skin abrasions caused by the claws. Surprisingly hen mortality from prolapse and cannibalism was higher ($p<0.05$) in cages fitted with abrasives. There are no other reports in the literature showing an increase in prolapse and cannibalism from hens using abrasives. ***(Asian-Aust. J. Anim. Sci. 2004. Vol 17, No. 10 : 1465-1471)***

Key Words : Laying Hens, Claw Abrasives, Mortality

INTRODUCTION

One of the criticisms of keeping birds in cages is the excessive length that claws can reach by the end of the laying period. This has been recognised in the European Union with a recommendation that cages be fitted with suitable claw shortening devices. When birds are placed in layers cages at 18-20 weeks the middle claw length of current strains of birds reared on the floor are about 18 mm and by end of lay in cages can measure more than 30 mm. During the laying period the claws of birds can cause skin abrasions on other birds especially during periods of disturbance. During some of these disturbances birds attempt to escape from the cage and can cause considerable injuries to other birds and to themselves. It is not uncommon for the claw of a bird to get caught on its own wing. Furthermore, even fairly short claws will still get sharp and may also be a potential source of injury to other birds (Hill, 1975; Ruszler and Quisenberry, 1979; Fickenwirth et al., 1985).

When birds are injured by claws there is the potential for cannibalism to develop, especially if there are bloodstains on birds, broken skin, raw wounds and injured vents. In these circumstances, forceful pecking will lead to pecking at the abrasion (Glatz, 2000) attracting other birds to join in the pecking. Death of the pecked bird usually results.

A low-cost, non-invasive method by which the claws of caged layers can be kept short and blunt can be achieved by fitting 8 mm strips of abrasive tape on the egg guard. Bird's claws scrape against this tape while they are feeding. This reduces the effectiveness of the claws to cause injury and feather loss and reduces the risk of entrapment (Tauson, 1986). The birds using the tape were easier to handle when taken out of the cages and when being handled at end of lay to transport to the abattoirs for slaughter. The durability and adhesive properties of the tape were found to be acceptable over the 3 experiments (Tauson, 1986).

Tauson (1986) found that abrasive strips did not improve the plumage condition nor have there been reports linking claw shorteners with an increase in cannibalism. Tauson (1986) found numerically higher (but not significant) mortality in his first experiment but lower mortality in the second and third experiment.

Tauson (1996) mentioned the use of abrasive paint as another method to improve the durability of the abrasive. Very fine sand is mixed in paint and the thick mixture is applied in a band on the egg baffle. Swedish egg producers have found that abrasive paint is effective as a claw shortener.

This trial was conducted to determine the effect of abrasive strips and abrasive paint in layers cages on claw length and claw sharpness, foot condition, feather cover and mortality of hens.

MATERIALS AND METHODS

Beak trimming procedure

Beak trimming was performed by a staff person from the pullet supply company. Use was made of a Lyon beak

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trimming machine to remove one half of the upper beak and one third of the lower beak from chickens at 7 days-of-age. Only those pullets with excessive regrowth of the beak were retrimmed at 12 weeks-of-age.

Birds and management

The Hyline Gold strain of laying hen was obtained from a commercial pullet grower at 20 weeks-of-age. Previously birds were vaccinated against Marek's disease at hatching, infectious bronchitis at 4 days and again at 4 weeks, avian encephalomyelitis at 10 weeks and fowl pox at 12 weeks. A coccidiostat was provided to the birds via the water during the rearing phase.

The laying phase for this experiment commenced in February 1999 (end of summer) and continued through to December 1999 (start of summer). A total of 960 laying hens (Hyline Gold) were housed 5 per cage in Harrison 'Welfare' back-to-back, single tier cages (each 500 mm wide by 545 deep; 545 cm^2/bird) in a fan ventilated insulated laying shed with louvered windows. The layer shed was equipped with evaporative coolers linked to a thermostat. The cooling operated when shed temperature at bird level reached 25°C. The temperature range in the shed during the experiment was 12-28°C. A high quality layer diet was offered *ad libitum* as mash with birds having free access to water from nipple drinkers. Incandescent lighting was provided in the layer shed and was held constant at 16 h per day. Light intensity in the shed ranged from 10-20 lux and was increased to 90-110 lux during bird inspection and egg collection. Food was provided to a depth of 2-4 cm and total feeding space for each bird at the front of the cage was 12.5 cm. Steel mesh (2.5×2.5 cm) was placed over the surface of the feed to reduce the ability of the hen to flick feed out of the hopper.

Experimental design

There were three treatments comprising; 1) control cages without abrasives, 2) treatment cages with two 8 mm wide abrasive strips fitted to egg guard and 3) treatment cages with an abrasive paint applied in one 5 cm strip to the egg guard. A randomised design was used for allocation of treatments with 32 replicates per treatment. A single replicate comprised 10 birds in two adjacent cages.

Application of abrasive strips and paint to egg guard of treatment cages

Abrasives were fixed to the Harrison cage egg guard, which is 490 mm×70 mm wide and angled into the cage at approximately 60°. A 25 mm wide roll of '3M-Safety Walk, General Purpose Black' abrasive tape was cut into 3 strips of approximately 8 mm. The egg guard was cleaned with acetone and allowed to dry. Two strips of the anti-slip tape were attached to the metal sheet egg guard on the rear of the feed trough. The strip was self-adhesive, 8 mm wide and 490 mm long, reaching along the entire length of the egg guard. One strip was fixed along the top of the egg guard parallel to the feed trough while the second strip was secured on the egg guard 10 mm below the top strip. For the Hyline Gold strain only two strips were stuck to the guard. Tauson (1986) recommended that giving medium weight hybrids access to 3 abrasive strips might cause excessive shortening of the claws and cause bleeding at the zone of ossification. More recently Tauson (pers. comm.) has recommended one abrasive strip per cage. The cost for the imported brand of abrasive strip for a 500 mm egg guard is approximately A$0.88/strip while for the Australian brand A$0.15/strip.

A sand and paint mixture as recommended by Tauson (pers. comm.) was prepared by Galaxy Abrasives (P1MF), Edwardstown, South Australia comprising the Australian equivalent of the Swedish paint product ("Technolac-Prime"; code: 168D46) mixed in a ratio of 1 litre of paint to 4.25 kg of find sand (0.4-0.8 mm). The mixture was stirred thoroughly. The egg guard was cleaned with acetone and allowed to dry. Painter's masking tape was stuck to the egg guard to allow the abrasive paint to be applied liberally to the egg guard in a 5 cm band. The paint was allowed 24 h to dry, the masking tape was removed and the birds then exposed to the abrasive paint. The cost to paint one cage with the abrasive was estimated at A$0.31/cage.

Data recording

Data was recorded on each experimental replicate of 10 birds in two adjacent cages. Birds were visually assessed for feather cover, body scratches, footpad and claw fold condition and claw sharpness using a 1-4 point scoring system. The middle claw on both feet was measured with a dressmaker's tape along the curvature of the claw. Claw length was measured on birds that died during the experiment and are reported over 3 age groups, 20-30, 31-42 and 43-60 weeks. Mortality was recorded daily and deaths as a result of injury, cannibalism and entrapment were noted as they occurred over the period 20-60 weeks.

Feather cover

At 20 weeks-of-age all hens were visually assessed for feather cover and then randomly allocated to the treatments. Feather cover and damage was recorded using a 4 point scale used by Tauson et al. (1986). The scoring system was applied to the neck, breast, back, wings, vent, tail, base of tail and legs as follows; score 4, for a part of the body having very good plumage with none or few worn or otherwise deformed feathers; score 3, for a part of the body where feathers have deteriorated but the skin is still or almost completely covered by feathers; score 2, for a part of the body that shows very clear deterioration of feathers and

Table 1. Claw length and claw sharpness (1, blunt; 4, sharp) at 20 and 60 weeks for control hens versus hens in cages provided with abrasive strip or abrasive paint (values at 20 weeks are prior to exposure to abrasives)

Treatment	Claw length at 20 weeks (mm)		Claw length at 60 weeks (mm)		Claw sharpness at 20 weeks		Claw sharpness at 60 weeks	
	Left claw	Right claw	Left claw	Right claw	Left claw	Right claw	Left claw	Right claw
Control	18.8	18.9	31.8a	31.5[a]	3.4	3.5	3.5[a]	3.6[a]
Strip	18.8	18.8	24.0b	23.7[b]	3.5	3.5	2.2[b]	2.2[b]
Paint	18.5	18.8	14.0c	13.6[b]	3.5	3.4	1.2[c]	1.1[c]
LSD (p=0.05)	NS	NS	0.9	1.0	NS	NS	0.3	0.2

NS: Not significant in analysis of variance. [a, b, c] Means within columns with different superscripts significantly differ at $p<0.05$.
LSD: Least significant difference.

or with larger naked areas; score 1, for a part of the body with heavily damaged feathers with no or only very small areas being covered with feathers. The average feather score for each individual part of the body and an overall average score were calculated for each replicate of 10 hens.

Foot condition (pads and claws)

Foot condition was scored at 20 and 60 weeks-of-age according to a 4 point scale used by Tauson (1986). The scoring system was; score 4, good condition of foot pads, digits and claw folds without lesions; score 3, lesions which were clearly visible but of minor importance and/or frequency, i.e. without inflammation or deep fissures; score 2, lesions which appeared at several places on the foot and to a certain degree considered severe; score 1, very poor condition with inflamed and/or bleeding lesions spread over several parts of the foot. A similar score condition was adopted for scoring degree of chipping and/or twisting of claws; score 4, short or normal length of claws with no chipping and no twisting of nails; score 3, claws starting to grow above normal with minimal chipping apparent; score 2, clearly over-grown claws with extensive chipping; and score 1, extremely overgrown claws with extensive chipping and/or twisting of nails.

Scratches on skin

A subjective method was adopted for scoring incidence and extent of scratches observed on birds; score 4, no scratches; score 3, minor scratches and skin abrasions (<1 cm in length); score 2, extensive scratches and skin abrasions (1-2 cm in length) and score 1, major scratches and skin abrasions (> 2 cm in length).

Claw sharpness

The middle claw was scraped on a persons finger nail and given a score of 4 if a large scratch was observed; score 3 if medium size scratch was observed; score 2 if small scratch was observed and score 1 if no scratch was left on the nail. This process was adapted from a simple field method of determining abrasiveness of rocks.

Abrasive score

A persons fingernail was scraped onto the abrasive in each cage at the end of the trial and given a score of 4 if a large scratch was observed; score 3 if a medium sized scratch was observed; score 2 if a small scratch was observed and score 1 if no scratch was left on the fingernail.

Wear on the abrasive strips and paint

Observations were made to determine if there was any differential wear observed on the abrasives at the end of the experiment i.e. after strips and paint had been utilised for 40 weeks by hens.

Statistical analyses

Base SAS software (SAS Institute, 1988) was used to perform an analysis of variance (by GLM procedure) to determine the main effects of claw abrasive treatments on claw condition, feather cover and mortality. Duncan's Multiple Range test (LSD) was used to separate treatment means at $p<0.05$.

RESULTS

No scratches or abrasions were observed on the skin of birds. For some birds the poorly feathered areas around the vent looked red and sore. In a previous anatomical study Glatz and Lunam (1996) showed that the vent region, despite the red colour on the surface, was not inflamed or sore. The red appearance is normal for layers as the blood vessels are very close to the skin surface around the vent region. Furthermore the skin thickness around the vent is less than all other regions on the body. This makes it a prime region for pecking attacks from other birds.

The middle claw length (left and right claw) of hens from the three treatments was significantly different (left claw, $p<0.05$, F-value=376.16, d.f.=2; right claw, $p<0.05$, F-value=393.45, d.f.=2) at 60 weeks. The birds using the abrasive paint had the lowest ($p<0.05$) claw length and claw sharpness (Table 1). Before the birds were exposed to the abrasives there was no significant difference in claw length or claw sharpness for the birds allocated to each of the experiments as would be expected. It was observed that there was a gradual increase in claw length of birds from 18-21 mm using the abrasive strip, including the controls, while the claw length of birds exposed to the abrasive paint

Table 2. Left and right foot claw length of birds, which died over the periods 20-30 weeks, 31-42 weeks and 43-60 weeks

Treatment	Claw length (20-30 weeks) (mm)		Claw length (31-42 weeks) (mm)		Claw length (43-60 weeks) (mm)	
	Left	Right	Left	Right	Left	Right
Control	24.7[a]	25.0[a]	24.5[a]	27.0[a]	27.2[a]	27.8[a]
Strip	16.9[b]	18.1[b]	18.7[b]	18.9[b]	21.4[b]	21.2[b]
Paint	14.8[c]	15.3[c]	13.0[c]	13.3[c]	14.8[c]	14.3[c]
LSD (p=0.05)	1.7	1.8	1.8	1.9	1.9	2.1

NS: Not significant in analysis of variance. [a, b, c] Means within columns with different superscripts significantly differ at p<0.05. LSD: least significant difference.

remained constant at about 14 mm (Table 2).

Overall feather score of hens and score for most body parts of birds from the three treatments was not significantly different at 60 weeks (Table 3). The exception was the better (p<0.05, F-value=219.86, d.f.=2) feather score of the tail of birds using the abrasive paint compared to the control and strip treatment (Table 3). The vent region on birds on all treatments had the poorest feather cover of any body part.

The right pad (p<0.05, F-value=270.92, d.f.=2), the right digit (p<0.05, F-value=269.95, d.f.=2) and the right claw (p<0.05, F-value=125.47, d.f.=2) of the birds using the abrasive paint were observed to have significantly (p<0.05) better condition than similar body parts on both the control hens and the hens using the abrasive strip (Table 4). No significant effects were observed for the left foot and claw fold.

Mortality from prolapse and cannibalism was significantly higher (p<0.05, F-value=3.12, d.f.=2) for birds using the abrasive strips and abrasive paint (Table 5). There was a trend for the overall mortality to be higher (approached significance at p=0.10) in the birds using the abrasive strips and abrasive paint compared to the control group.

Table 5. Abrasive score (1, not abrasive; 4, highly abrasive) for treatment cages at end of trial, overall mortality and mortality from prolapse and cannibalism (values at 20 weeks for all mortality was zero)

Treatment	Abrasive score	Overall mortality (%)	Mortality from prolapse and cannibalism (%)
Control	1.00[a]	4.7	1.6[a]
Strip	2.03[b]	10.9	5.9[b]
Paint	3.09[c]	9.4	6.3[b]
LSD (p=0.05)	0.09	NS (p=0.10)	4.2

NS: Not significant in analysis of variance. [a, b, c] Means within columns with different superscripts significantly differ at p<0.05. LSD: least significant difference; note that overall mortality % approached significance at p=0.10.

There was a higher (p<0.05, F-value=884.55, d.f.=2) abrasive score obtained for the abrasive paint compared to the abrasive strip after 40 weeks of use by the hens (Table 5).

None of the 128 abrasive strips installed on the egg baffle came loose. The left and right ends of the tape on the baffle (nearest to the cage sidewall) were not used as extensively as centre portion of the strips. The galvan from the metal on the baffle formed a 'solder-like' seal with the glue on the upper edge of each strip. Presumably the constant abrasion of the claw on the galvanised iron baffle and the abrasive strip caused this unusual bonding between glue and metal. There were some manure stains noticed on the baffle and strips.

In contrast to the abrasive strips the abrasive paint was chipped off in various sections along the baffle. The ends of the paint strips on the baffle (areas nearest to the cage sidewalls) were not used as extensively as centre portion of

Table 3. Feather score (1, poor; 4, good) of body parts at 60 weeks for control hens versus hens in cages provided with abrasive strip or abrasive paint (values at 20 weeks for all treatments prior to exposure to abrasives were not significantly different)

Treatment	Neck	Breast	Back	Tail	Base of tail	Vent	Legs		Wings		Overall core
							L	R	L	R	
Control	2.98	2.68	2.92	2.50[b]	2.67	2.42	3.15	3.09	3.23	3.34	2.88
Strip	3.03	2.65	2.85	2.50[b]	2.43	2.39	2.94	2.91	3.22	3.20	2.80
Paint	3.04	2.83	3.01	2.71[a]	2.68	2.30	3.17	3.14	3.34	3.34	2.97
LSD (p=0.05)	NS	NS	NS	0.2	NS	NS	NS	NS	NS	NS	NS

NS: not significant in analysis of variance. [a, b, c] Means within columns with different superscripts significantly differ at p<0.05. LSD: least significant difference, L: left; R: right.

Table 4. Foot and claw condition (1, poor; 4, good) at 60 weeks for control hens versus hens in cages provided with abrasive strip or abrasive paint (values at 20 weeks for all treatments prior to exposure to abrasives were not significantly different)

Treatment	Left pad	Right pad	Left digit	Right digit	Left claw fold	Right claw fold	Left claw	Right claw
Control	3.35	3.30[ab]	2.46	2.35[b]	2.92	2.97	3.14	3.12[b]
Strip	3.27	3.23[b]	2.39	2.37[b]	2.88	2.88	3.13	3.16[b]
Paint	3.41	3.40[a]	2.56	2.61[a]	2.96	3.00	3.27	3.31[a]
LSD (p=0.05)	NS	0.11	NS	0.20	NS	NS	NS	0.15

NS: Not significant in analysis of variance. [a, b, c] Means within columns with different superscripts significantly differ at p<0.05. LSD: least significant difference.

the strips. It was estimated that about 80% of the painted surface remained intact after 40 weeks of use. Most of the chipping of paint occurred about 10 cm's from the end of each baffle. There was some manure stains on the baffle and paint.

DISCUSSION

The 7.8 mm reduction achieved in middle claw length using the two 8 mm abrasive strips in this current work was greater than the 3.6 mm reduction achieved in the Queensland studies using a 12.5 mm wide abrasive strip (Stewart and Dingle, 1997). However, in Europe, Rauch (1992) and Tauson (1986) achieved a two fold reduction in claw length (15 mm) using the same area of abrasive tape that was used in the current study.

The abrasive paint used in the current study was far more effective as a claw shortener probably because the area of abrasive paint provided was far greater than provided by the abrasive strips. Applying the paint in similar strips as the tape might enable the bird to chip the paint off more easily. The reduction in claw length achieved with the abrasive paint, however, was the same reduction achieved by the abrasive strips in the European work.

It was much easier and it took less time to apply the paint to the egg guard compared to sticking the abrasive strips to the egg guard. There was more time involved in cutting the 3 strips from the 25 mm roll, then cutting these strips into appropriate lengths, removing the backing of the tape (which can be a time consuming exercise) and then sticking the tape onto the egg guard. It was simpler and quicker to apply the pre-prepared paint and sand mixture onto the egg guard with a spatula. Later on when the abrasive paint wears off it would also take less time to apply a second coat of paint compared to scraping the used abrasive tapes from the egg guard and sticking on the new tape. The key finding in this trial was that abrasive paint was more effective in achieving a reduction in claw length than strips and is recommended for use where farmers are confident abrasives in the cage are not going to result in an increase in mortality.

Overseas results indicate that abrasive strips either reduce mortality (Ruszler and Kiker, 1975; Ruszler and Quisenberry, 1979; Martin et al., 1981; Goodling et al., 1984) or mortality is not effected by use of abrasive strips (Tauson, 1986).

One of the original reasons for reducing claw length was to minimise skin abrasions caused by the claws and reduce mortality. This study showed that cannibalism and mortality increased when abrasives were used. The major difference between European and the Australian conditions is the light intensity to which the birds are exposed. Under European conditions light intensity is usually 5 lux or less while in this current experiment light intensity in the shed ranged from 90-110 lux during egg collection, feeding and bird inspections and 10-20 lux for the remainder of the time.

Once a death occurs in a cage from cannibalism other deaths of birds in the cage normally follow (Glatz, 2000). This situation was apparent in the current experiment, where there were a number of cages where multiple deaths occurred in cages fitted with the abrasive strip and abrasive paint. Reports from Industry indicate that the strain used in the study had a reputation for pecking.

In the Ratite Industries maintenance of hide quality is crucial and every effort is made by farmers to minimise any object in the environment that can cause skin abrasions. Damage to the hide can occur especially when the bird rubs against these objects when it is stressed or frightened. It seems logical that including an abrasive object in a cage for laying hens must greatly increase the risk of the bird suffering from an abrasion especially when faeces were observed on the strips and the paint. It could be argued that the location of abrasives in the cage would have made it difficult for a bird to abrade itself, but faeces were noticed on the strips and the paint indicating the vent was in close proximity. No scratches were observed on live birds possibly because those that did receive an abrasion were pecked and died. There may be a need to use less abrasive tapes or paint under Australian conditions. Furthermore, there needs to be an assessment of whether minor skin abrasions received by birds from other parts of the cage structure are contributing to the problem of cannibalism.

The other concern in the current experiment was the inconsistent beak length and beak condition of the birds delivered as pullets. Up to 10% of the birds were severely trimmed while a further 10% of birds needed a further retrim. It is likely that the birds needing retrimming were the birds responsible for the cannibalism. By chance at housing there might have been a disproportionate number of birds with long beaks placed in these cages fitted with abrasives, relative to the control cages, although this seems unlikely.

Another factor worth considering as an explanation for the increase in mortality is that blunting of the claws removes one of the defensive weapons of birds. Those birds with a longer and sharper beak might be able to exert even greater dominance over other birds in the cage with shorter beaks. The claws are used as weapons to inflict injury on competitors, maintain status in the social hierarchy and can alter the behavioral patterns in other birds of the flock (Ruszler and Quisenberry, 1979). There needs to be further studies to determine whether the increase in mortality due to abrasives can be repeated.

Tauson (1986) showed that abrasive tape had an immediate impact on claw length. This was also demonstrated in the current study with a significant

reduction in claw length being achieved by 31 weeks-of-age. The hens used the tape quite intensively by scratching with their feet on the egg guard as they were feeding.

Tauson (1986) reported inferior foot condition in a group of birds at 52 weeks-of-age. In contrast in the current experiment it was noted that foot condition was significantly improved for the right foot. It was clear that the birds were not abrading their footpad on the abrasives. Instead the lesions were probably caused by hyperkeratosis, a condition on the footpads and digits caused when birds stand on wire. Reasons for the improvement in the foot pad condition of the right foot could be resolved by undertaking biomechanical studies which involves measuring the pressure exerted on the footpad and toes during walking and standing on wire.

No significant differences in plumage condition were found between birds using the abrasives and the control hens, which agree with the results of Tauson (1986). Likewise Compton et al. (1981) and Vanskike and Adams (1983) found no differences in feather cover between normal and declawed hens. It was expected that the feather cover of the back of hens might have been improved. The reduced claw length would have minimised the impact of the claws on the feathers during trampling as reported by Hill (1975) and Fickenwirth et al. (1985). It was noticed however, that the feather cover of the tail of hens using the abrasive paint was superior to the control and the abrasive strip treatment. The tail feathers are pecked at extensively by other birds in the cage, and could be classified as stereotype pecking behaviour. While the evidence is not convincing, it might be suggested that birds with the shortest claws were less stressed and engaged in reduced stereotype pecking resulting in better feather cover on the tail.

In conclusion abrasive paint was more effective as a claw shortener than abrasive strips probably because of the greater area of abrasive made available. The birds using the abrasive paint had the lowest claw length and claw sharpness. Mortality from prolapse and cannibalism was higher in cages fitted with abrasives questioning the value of fitting abrasives to layer cages under Australian conditions. If abrasives in cages are responsible for the increase in cannibalism observed then their use cannot be recommended until further work is undertaken to verify the findings. In Europe a council directive, which requires that all cages shall be fitted with suitable claw shortening devices, may not be applicable under Australasian conditions.

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