Effect of Poor Feather Cover on Feed Intake and Production of Aged Laying Hens

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ABSTRACT : The effect of poor feather cover on feed intake and production was examined in two commercial strains of layers (tinted and brown egg) over 91-98 weeks of age. Hens were housed at four per cage (600 cm^2/bird) in a commercial layer shed which ranged in temperature from 13.2 to 16.8℃. At the start of the experiment 50% of the birds were classified as having poor feather cover. Feather score was highly correlated with feed intake. Poor feather cover on the neck and the back were the best indicators of hens with high feed intake. Feed intake of hens with poor feather cover was 16% higher ($p<0.05$) than hens with good feather cover. Hens with good feather cover produced more eggs ($p<0.05$) early in the trial and had a higher ($p<0.05$) liveweight, but there was no significant differences in egg weight. Feed per dozen eggs was superior ($p<0.05$) in hens with good feather cover. Feather cover on the back and vent were the best indicators of overall feather score, while the tail, base of tail and vent were the body parts most affected in birds with poor feather cover. *(Asian-Aust. J. Anim. Sci. 2001. Vol. 14, No. 4 : 553-558)*

Key Words : Laying Hens, Feather Cover, Feed Intake, Egg Production

INTRODUCTION

It is well known that feather cover of laying hens declines as the hen ages (Tauson, 1984). By the end of a lay some hens are almost naked. When hens lose their feathers over large parts of their body due to feather pecking (Savory, 1995) or from poor beak trimming (Glatz, 2000), abrasion and moulting there is a decline in their natural heat insulation and increase in convective heat loss from the bird (Mitchell, 1985) and an increase in heat production (Nichelman et al., 1986).

Feed consumption increases when the plumage cover decreases (Emmans and Charles, 1976; Biedermann et al., 1993; Damme and Pirchner, 1984). Compared to fully feathered hens, naked birds can eat 41 g/bird more at 15℃ and 31 g/bird at 18℃ (Tauson and Svennson, 1980).

Poor plumage cover has also been shown to decrease efficiency of feed utilisation (ONeil et al., 1971; Leeson and Morrison, 1978; Tauson and Svensson, 1980; Tullet et al., 1980; Damme and Pirchner, 1984; Raastad and Katle, 1989). Low efficiency hens have poorer plumage on the neck and breast, and the poorer the plumage the more agitation hens show (Raastad and Katle, 1989). In contrast, Hagger et al. (1989) reported improved conversion from hens with poor feather cover.

White Leghorn birds with no feather cover had higher egg weight but egg production was 9.2 and 6.4% lower at 12.8 and 23.9℃, while at 33.9℃ egg production was 5.5% higher compared to fully feathered hen (Peguri and Coon, 1993). In heavier breeds at peak egg production there is no effect of defeathering on production, but by 40 weeks of age, there is a strong relationship between feather loss and body weight deterioration although poorly feathered hens showed a higher egg mass output (Damme and Pirchner, 1984). Charles (1980) reported that poor feather cover depresses production whereas Hagger et al. (1989) reported higher egg production. Brown egg layers with intact plumage had reduced mortality, a higher egg production, lower feed consumption and fewer cracked eggs (Biedermann et al., 1993).

Mills et al. (1988) reported a negative correlation in 52-week-old layers between feathering and egg production but a positive correlation between feathering and age at first egg. In contrast, Bessei (1984) found a negative correlation between feather condition and age at first egg.

The above research findings indicate that feed consumption could be 30% higher in hens with the most worn plumage. In Australia during winter or more particularly when environmental temperatures are below 20℃, hens could be consuming millions of dollars of additional feed. It is not known what proportion of hens in an aged flock have poor feather cover and whether group housing of hens in cages under commercial conditions reduces the impact of poor feathering on feed intake. The aim of this trial was to validate the research findings and determine the influence of poor feather cover on feed intake and production of laying hens housed under commercial conditions.

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MATERIALS AND METHODS

Beak trimming procedure

A person with extensive commercial experience used a Lyon 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

Two strains of laying hens (Tegel Tint and Tegel Brown) were obtained from a commercial pullet grower at 17 weeks of age. From 17-86 weeks hens were housed in the shed for their normal production phase. During the feather cover study (87-98 weeks) hens were fed a mash diet (g/kg) comprising:

Wheat 200; peas 113; triticale 400; lucerne hay 25; meat meal 102; soyabean meal 50; limestone 80; methionine 2; salt 1, canola oil 25; premix of vitamins, trace elements and yolk colorant 2. Minimum calculated levels of metabolizable energy (ME), crude protein (N×6.25) and calcium for the layer diet were 11.5 MJ/kg; 17.6% protein and 3.1% calcium.

Previously birds were vaccinated against Marek's disease at hatching, infectious bronchitis at 4 days of age and again at 4 weeks of age, avian encephalomyelitis at 10 weeks of age and fowl pox at 12 week-of-age. A coccidiostat was provided to the birds via the water during the rearing phase.

The laying phase for the feather cover experiment commenced in July (mid winter) and continued through to September (early spring). The temperature range in the shed during this period was 13.2 to 16.8℃ Hens were housed 4 per cage in 192 Harrison Welfare back-to-back, single tier cages (each 500 mm wide by 545 deep; 600 cm^2/bird) in a fan ventilated insulated laying shed with louvred windows. The diet was offered *ad libitum* as mash with free access to water from nipple drinkers. Incandescent lighting was provided in the layer shed and was held constant at 16 h per day. Feed was provided to each replicate in custom built feed hoppers. The hoppers could be removed from the cage to enable both easy weighing of feed into hoppers and weighing of the feed residue. Feed 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 the feed out of the hopper.

Experimental design and analysis

For the experimental phase there were 4 treatments involving 2 feather cover treatments (poor and good feather cover) and 2 strains (*Tegel* Tint and *Tegel* brown). A randomised design was used for allocation of treatments with 22 replicates per treatment. Each replicate comprised 8 birds housed 4/cage in 2 adjacent cages. Base SAS software (SAS Institute, 1988) was used to perform an analysis of variance (by GLM procedure) to determine the effects of the main factors feather cover, strain and interactions on feed intaket and production parameters. Duncan's Multiple Range test was used to separate treatment means at $p<0.05$. The PROC CORR procedure in SAS was used to determine the correlation between feed intake and feather cover.

Production measurements

Egg production was recorded daily, feed intake weekly and egg weight determined on 3 consecutive days every 4 weeks.

Plumage condition measurement

At 87 week-of-age all hens were visually assessed for feather cover and allocated to the treatments. At the commencement of the experiment (91 weeks) hens were individually taken out of their cage and examined for feather cover and damage using a scoring system similar to that used by Tauson (1984). The scoring system was a 4-point score 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 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.

RESULTS

Feather cover of hens

Overall feather cover of hens from the four treatments was significantly different ($p<0.05$) both at the commencement and conclusion of the experiment (table 1). Feather cover of body areas at 91 weeks (table 3) was also different ($p<0.05$) between the treatments. The body parts with the poorest feather cover were the tail and base of tail for the Tegel Tint and the base of tail and vent for the Tegel Brown (table 3). The hens with poor feather cover at the commencement of the trial showed an improvement ($p<0.05$) in feather score by the end of the experiment. In contrast, the hens with good feather cover at the start of the trial showed a deterioration ($p<0.05$) in feather score by the end of the experiment

Table 1. Feather score and liveweight at 91 and 98 weeks for hens with poor and good feather cover

Treatment	Feather score at 91 weeks	Feather score at 98 weeks	Liveweight at 91 weeks (kg)	Liveweight at 98 weeks (kg)
Poor tinted	2.176[c]	2.283[b]	2.070[c]	2.148[c]
Good tinted	2.760[a]	2.574[a]	2.161[b]	2.201[bc]
Poor brown egg	1.479[d]	1.624[d]	2.152[b]	2.251[b]
Good brown egg	2.374[b]	2.080[c]	2.332[a]	2.390[a]
LSD (p=0.05)	0.121	0.157	0.064	0.086

[a,b,c] Means within columns not followed by the same letter are significantly different at p<0.05.
LSD=least significant difference.

Table 2. Simple correlation coefficients (r) of feather score at 91 weeks with weekly feed intake over 91-98 weeks

Feed intake (weeks)	Neck	Breast	Back	Tail	Base of tail	Vent	Legs	Wings	Overall score
91	-0.73	-0.75	-0.74	-0.62	-0.67	-0.70	-0.72	-0.71	-0.76
92	-0.69	-0.72	-0.74	-0.56	-0.64	-0.68	-0.74	-0.69	-0.75
93	-0.74	-0.74	-0.77	-0.68	-0.74	-0.75	-0.72	-0.75	-0.81
94	-0.77	-0.71	-0.77	-0.65	-0.70	-0.67	-0.70	-0.75	-0.78
95	-0.72	-0.66	-0.70	-0.58	-0.65	-0.66	-0.65	-0.65	-0.71
96	-0.73	-0.68	-0.73	-0.66	-0.71	-0.70	-0.63	-0.71	-0.76
97	-0.74	-0.66	-0.75	-0.65	-0.72	-0.69	-0.59	-0.72	-0.76
98	-0.74	-0.66	-0.74	-0.65	-0.71	-0.68	-0.60	-0.71	-0.75
Ave (91-98)	-0.73	-0.70	-0.74	-0.63	-0.70	-0.70	-0.68	-0.71	-0.76

Table 3. Feather score of individual body parts at 91 weeks for hens with poor and good feather cover

Treament	Neck	Breast	Back	Tail	Base of tail	Vent	Legs	Wings	Overall score
Poor tinted	2.156[b]	2.106[b]	2.320[b]	1.625[c]	1.833[c]	2.039[c]	2.805[b]	2.570[b]	2.1768[bc]
Good tinted	2.578[a]	2.359[a]	2.953[a]	2.414[a]	2.969[a]	2.828[a]	3.046[a]	2.937[a]	2.7607[a]
Poor brown egg	1.479[c]	1.521[c]	1.469[c]	1.719[d]	1.141[d]	1.417[d]	2.073[c]	1.568[d]	1.479[d]
Good brown egg	2.141[b]	2.223[a]	2.386[b]	2.109[b]	2.125[b]	2.582[b]	3.087[a]	2.342[c]	2.374[b]
LSD (p=0.05)	0.151	0.151	0.182	0.184	0.212	0.230	0.198	0.169	0.121

[a,b,c,d] Means within columns not followed by the same letter are significantly different at p<0.05.
LSD=least significant difference.

(table 1).

Correlations

There was a significant negative correlation (p<0.05) between weekly feed intake (from 91-98 weeks of age) and feather score at 91 weeks (table 2). Feather score on back and neck showed the highest correlation with feed intake (table 2). The back and the vent were the best indicators of overall feather score (table 4). The tail and base of tail were the body parts most affected in birds with poor feather cover.

Production

Liveweight of hens from the four treatments was significantly different (p<0.05) both at the commencement and conclusion of the experiment (table 1). Birds with poor feather cover had higher (p<0.05) feed intake (table 5) than birds with good feather cover (table 5). Egg production (table 6) was lower (p<0.05) for birds with poor feather cover in the first week of the trial and remained consistently lower throughout the experiment (table 6). There was a trend for birds with poor feather cover to produce heavier eggs (P=0.08, table 7) but poorer (p<0.05) FCE than hens with good feather cover (table 8).

DISCUSSION

At the start of the trial 50% of hens in the trial were classified as having poor feather cover. The deterioration in feather cover begins soon after the hens are caged. By 40 weeks of age a considerable proportion of the birds have significant feather wear and bare patches. During winter, and even during cool nights in summer, this poor feather cover could cause

Table 4. Simple correlation coefficients (r) between body parts for feather score

Body part	Neck	Breast	Back	Tail	Base of tail	Vent	Legs	Wings	Overall score
Neck		0.525	0.589	0.499	0.451	0.534	0.477	0.581	0.716
Breast			0.562	0.554	0.463	0.658	0.604	0.513	0.753
Back				0.606	0.745	0.639	0585	0.639	0.852
Tail					0.675	0.681	0.493	0.573	0.809
Base of tail						0.607	0.496	0.559	0.812
Vent							0648	0549	0.850
Legs								0.511	0.758
Wings									0.770

Table 5. Effect of feather cover and strain on feed intake (g/bird/day)

	Weeks of age								
Treatment	91	92	93	94	95	96	97	98	Ave
Feather Cover									
Good	111.5[a]	117.1[a]	115.6[a]	115.4[a]	118.5[a]	113.5[a]	114.7[a]	116.8[a]	115.4[a]
Poor	131.3[b]	137.2[b]	134.8[b]	133.6[b]	135.8[b]	132.8[b]	133.1[b]	128.6[b]	133.4[b]
LSD	4.2	5.4	4.4	4.7	5.4	4.9	4.3	6.9	3.4
Strain									
Brown	128.2[a]	135.5[a]	133.6[a]	133.0[a]	134.8[a]	130.4[a]	131.5[a]	128.7[a]	131.9[a]
Tint	111.7[b]	115.1[b]	113.1[b]	112.2[b]	116.0[b]	112.7[b]	113.0[b]	114.1[b]	113.5[b]
LSD	4.3	5.5	4.4	4.8	5.5	4.9	4.4	7.0	3.5

[a,b] Means within columns within comparison not followed by the same letter are significantly different at $p<0.05$.
LSD=least significant difference.

Table 6. Effect of feather cover and strain on egg production (%)

	Weeks of age								
Treatment	91	92	93	94	95	96	97	98	Ave
Feather Cover									
Good	44.4[a]	41.1	38.6	36.5	37.2	34.6	33.2	33.8	37.4
Poor	39.2[b]	37.3	36.7	35.8	32.4	31.7	30.9	33.1	34.6
LSD.	5.0	ns	ns	ns	ns	ns	ns	ns	ns
Strain									
Brown	40.9	40.3	38.2	37.2	36.0	33.1	32.1	33.6	36.4
Tint	42.8	37.4	36.8	34.6	32.9	33.1	31.9	33.2	35.3
LSD	ns	ns	ns	ns	ns	ns	ns	ns	ns

[a,b] Means within columns within comparison not followed by the same letter are significantly different at $p<0.05$.
LSD=least significant difference.
ns=not significant.

a large increase in feed intake.

In this current trial where environmental temperatures ranged from 13.2 to 16.8℃, the increase in feed intake attributable to poor feather cover was 18 g/bird/day. The research reports (Tauson and Svenson, 1980; Peguri and Coon, 1993) indicate that naked birds consume an extra 26-31 g/bird at equivalent temperatures. Consequently farmers can suffer considerable increases in feed costs because of poor feather cover of hens. The hens used in the current trial were older and had poorer production than birds that are normally kept under commercial conditions. Nevertheless the results provide an indicator of potential differences in feed intake that can be caused by poor feather cover under commercial conditions. It was expected that birds housed in groups could huddle together to minimise the heat loss shown by birds caged individually for metabolic studies. It is apparent, however, that those results reported in the literature are relevant for field conditions as demonstrated in the current trial.

In this current trial birds which had poor feather cover had lower egg production in the first week of the trial and numerically thereafter, which agrees with most reports from the literature (Charles 1980; Biedermann et al., 1993; Peguri and Coon, 1993). The

Table 7. Effect of feather cover and strain on egg weight (g)

	Weeks of age								
Treatment	91	92	93	94	95	96	97	98	Ave
Feather Cover									
Good	67.5	68.6	68.1	69.2	69.4	68.6	69.5	68.7	68.6
Poor	67.9	68.9	69.1	69.7	69.8	67.8	69.8	69.1	68.9
LSD	ns	ns	ns	ns	ns	ns	ns	ns	ns
Strain									
Brown	67.5	68.4	68.7	68.9	68.6	68.3	69.4	69.7	68.4
Tint	67.9	69.3	68.4	70.2	69.9	69.5	69.9	69.8	69.2
LSD	ns	ns	ns	ns	ns	ns	ns	ns	ns

LSD=least significant difference.
ns=not significant.

Table 8. Effect of feather cover and strain on FCE (kg/dozen eggs)

	Weeks of age								
Treatment	91	92	93	94	95	96	97	98	Ave
Feather Cover									
Good	3.3^a	3.8^a	3.9^a	4.3	4.3^a	4.5^a	4.5^a	4.7	4.0^a
Poor	4.3^b	4.9^b	5.2^b	5.2	6.5^b	5.8^b	6.5^b	5.6	5.1^b
LSD	0.7	0.8	1.0	ns	1.9	1.2	1.7	ns	0.8
Strain									
Brown	4.2^a	4.6	5.0^a	5.1	5.8	5.7^a	6.3^a	5.7a	4.9^a
Tint	3.3^b	4.0	3.9^b	4.2	4.8	4.4^b	4.5^b	4.4b	4.0^b
LSD	0.7	ns	1.0	ns	ns	1.2	1.7	1.1	0.8

^{a,b} Means within columns within comparisons not followed by the same letter are significantly different at $p<0.05$.
LSD=least significant difference.
ns=not significant.

exception to this is when birds are at peak of lay (Damme and Pirchner, 1984) or exposed to high environmental temperature (Peguri and Coon, 1993). Feed conversion efficiency was inferior because of poor feather cover which supports the findings already reported in the literature. Raasted and Katle (1989) indicated that birds with poor plumage on the neck and breast had poor feed conversion efficiency. The present trial suggests that poor feather cover on the neck and back contribute more to high feed intake in hens and subsequently poorer feed conversion efficiency. The back is more exposed to the environment than the breast and a naked back with the larger surface area might be expected to have a greater heat loss than the breast. Body weight of hens with poor feather cover was lower supporting the findings of Damme and Pirchner (1984).

It is clear from current study that there is a close relationship between feather cover and feed intake. Poultry farmers should monitor feather cover regularly and those birds with considerable feather loss on the back and neck consume most feed. Some birds do scratch the feathers from the backs of birds with their claws. This could be prevented by installing abrasive strips on the egg guard (Tauson, 1986).

For many years poultry farmers have been using antiseptic coloured sprays to treat pullets and hens suffering from injuries caused by cannibalism, scratches and abrasions. There is evidence that these stock wound sprays prevent further aggressive feather pecks from other hens and feathers begin to grow back in the sprayed area (R. Bishop, pers. comm.). More extensive use could be made of sprays on poorly feathered birds especially late in lay to prevent further feather pecking and improve feather cover.

In an interesting finding in the current study were hens with poor feather cover, which were housed together showed an improvement in feather cover. It is recommended that as farmers undertake their daily bird checks, they remove birds with poor feather cover and place them in separate cages. Feather cover of these birds will improve and reduce feeding costs. Some poultry workers make the mistake of culling poorly feathered birds without checking whether they are producing eggs.

There has been an emphasis on commercial egg farms to ensure cooling is provided to birds in summer but little consideration given to keeping birds warm in winter. Farmers may be able to heat sheds (which have adequate insulation) in winter. For this

strategy to be viable the heating costs would have to be lower than the expected increase in feeding costs because of poor feather cover. Alternatively young birds with good feather cover could be housed in winter to take advantage of the deteriorating feather cover in summer which will be an advantage for hens subject to hot weather (Peguri and Coon, 1993).

In conclusion the results of the trial show that farmers can suffer considerable increases in feed costs and losses in egg income because of poor feather cover of hens in winter. If the assumption is made that half of the Australian layer flock has poor feather cover and are subject to environmental temperatures below 20℃ for 50% of the time they are housed, then increases in feed costs amounts to $6.57m annually. This is based on the extra feed intake of 18g/bird/day with feed priced at $AUS 400/tonne.

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