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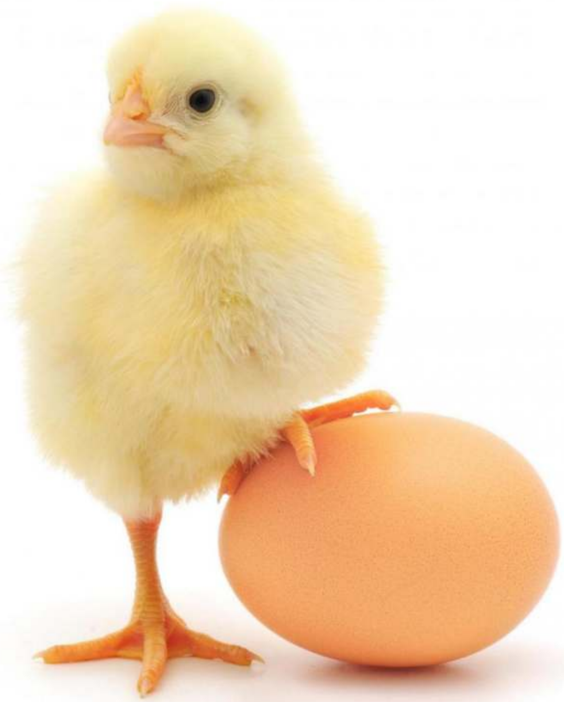

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The Effect of Beak Length and Condition on Food Intake and Feeding Behaviour of Hens

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Abstract: Hens (70 weeks-of-age) with short (10-11 mm), long (13-15 mm) and divided upper beaks (1-3 mm difference in beak length between the left and right sides of the upper beak) were selected from a flock of hens beak trimmed at hatching and re-trimmed at 14 weeks. Hens were switched from a mash diet to various whole grain diets at weekly intervals in order to determine the effect of beak length and condition on food intake, feeding behaviour and particle mix consumed from diets. Birds switched from a mash diet to a mixture of whole grain diets suffered a 22.6 g/day drop ($P < 0.05$) in food intake while, conversely, birds changed from a maize and wheat diet to a sorghum and wheat diet had a 28.4 g/day increase ($P < 0.05$) in food intake. For all diets, birds with short upper beaks consumed 7.8 g/day less ($P < 0.05$) than birds with long upper beaks with divided beak birds intermediate in food intake. Feeding rate of divided beak birds (4.0 mg food/sec) was significantly ($P < 0.05$) less than short beak birds (5.3 mg food/sec) with long beak birds intermediate (5.0 mg food/sec). Birds with a short upper beak made significantly ($P < 0.05$) more pecks at the water nipple than divided beak birds. These studies demonstrated that beak condition of layers has important implications for egg farmers. The performance of birds with short upper beaks might be adversely affected when fed free choice or whole grain diets.

Key words: Laying hens, beak trimming, beak length, particle size, feeding behaviour

Introduction

Laying hens are normally beak-trimmed at a very early age to control subsequent pecking behavioural vices (Glatz, 2000). After trimming, some young chicken's experience a drop in food intake and body weight but its severity depends on the amount of beak removed (Glatz and Lunam, 1994). In some instances the effects of beak trimming on body weight and food intake remains throughout the bird's life and they continue to eat less food than non-trimmed birds (Glatz, 1990). Beak trimming removes sensory receptors, with a subsequent reduction in feed intake (Glatz and Lunam, 1994), pecking efficiency (Gentle *et al.*, 1982), loss of temperature and touch responses (Gentle, 1986b) and behavioural evidence (hyperalgesia and guarding behaviour) for persistent pain (Duncan *et al.*, 1989; Gentle *et al.*, 1990). Traumatic-neuromas in the beak stump after trimming have been implicated as a cause of chronic pain in commercial hens (Breward and Gentle, 1985; Gentle, 1986a; Lunam *et al.*, 1996). Several authors have reported greater inactivity in beak trimmed birds, possibly as a consequence of chronic pain (Duncan *et al.*, 1989; Lee and Craig, 1990). Poor beak trimming often results in hens with poor beak condition (bubble beaks, split beaks and short beaks) and these birds are likely to have difficulty in feeding especially on free choice diets where particle size of the ingredients varies greatly (Glatz, 2000).

Hargreaves and Champion (1965) reported that beak-trimming one half or three quarters of the beak did not result in any loss of egg production, but reduced food consumption and body weight gain. Examination of the lengths of beaks of hens from flocks on commercial farms (Woolford *et al.*, 1990) revealed that there was a great variation in the length and condition of beaks. Glatz (2002) also showed that severity of beak trimming and cauterization time had a significant influence on beak regrowth and body weight. In addition, there have been numerous anecdotal reports from industry of hens selecting different particle sizes and grains from diets and leaving fine residues in the food trough. The objective of this study was to examine the effects of beak length and condition of beak on food intake and particle mix taken from whole grain diets on feeding efficiency and behaviour.

Materials and Methods

Rationale for methodology: Hens with various beak lengths and condition are common in the egg industry (Glatz, 2000). During the laying year birds often receive diets varying in particle size, particularly those birds provided whole grain diets. The rationale for the study was to expose birds to frequent changes of diets to simulate the worst case scenario. The impact of diet changes on birds with varying beak condition under these circumstances would replicate the situation in industry when a change in diet is introduced. Normally it is recommended to accustom birds to a change in diet by mixing the old ration with the new but under practical conditions this is not possible.

Birds and management: From a flock of 70 week-old layers, 10 individual hens of each beak type were retained as follows; i) hens with a short (S) upper beak (10-11 mm); ii) hens with a long (L) upper beak (13-15 mm) and iii) hens with a divided (D) upper beak (1-3 mm difference in beak length between left and right sides of upper beak). Beaks were measured with a vernier calliper from the anterior edge of the nare to the tip of the beak. Treatment birds were housed individually in a randomized design in cages (53 cm x 45 cm x 53 cm) of the type they had been occupying for the previous twelve months in a naturally ventilated layer shed. The daily photoperiod was from 0400 h – 2000 h.

Beak trimming: Birds had been previously block trimmed at hatching with a re-trim at 14 weeks-of-age. It is not known how a divided upper beak forms but it might occur after the re-trim if the beak is cut on a warped cutting bar. In this situation only the centre portion of the top beak will be adequately cauterized. As a result the outer edges of the top beak could re-grow more than the centre portion because of the differential cauterization, resulting in a split beak.

Schedule of diets: For the previous 12 months birds had been eating a mash diet. After a settling-in period, the following schedule of diets was provided and individual hen food intake was measured for the 30 hens in the treatments.

Week 1: Mash diet.
Week 2: Equal mixtures (25% each) of the following diets; i) sorghum, wheat and canola, ii) sorghum, wheat and sunflower, iii) maize and wheat and iv) sorghum and wheat.
Week 3: Sorghum, wheat and canola diet.
Week 4: Sorghum, wheat and sunflower diet.
Week 5: Maize and wheat diet.
Week 6: Sorghum and wheat diet.
Week 7: Repeat feeding of sorghum and wheat diet.

Ingredients of the diets are presented in Table 1 and the particle size composition in Table 2. Each bird received 2 kg of each diet at the beginning of each week, with an initial feed depth in the trough of approximately 8 cm.

Sieving of Diet: Diet samples and food residues were sieved to determine the consumption of different sizes of particles. Sieving of the food was done with a Scientific Equipment Manufacturing (Adelaide, South Australia) slot sieve comprising 6 sieves with sizes of 0.5, 1.0, 1.5, 2.0, 2.5 and 3.0 mm. All were rectangular slot sieves except for the 0.5 mm sieve, which comprised 0.5 mm diameter holes. Food was placed in the top tier of the machine and allowed to shake for 1 min to separate the different particle sizes of food.

Video recording of feeding behaviour: During week 7, while birds were feeding on the sorghum and wheat diet, two sets of video records were made for each bird with measurement of individual food intake. The first video record was a time lapse recording (1/8th speed) over a complete 16 h photoperiod with food available *ad libitum.* Three days later birds were deprived of food from 1200 h to 1500 h to induce a mild state of hunger and then a second set of video records were made for 30 min at normal speed from 1500-1530 h and 1700-1730 h.

Viewing videotapes: Videotapes were viewed and data transferred to event recorders for statistical computation and analysis. For the time lapse recordings, measurement were made only of the total eating time and number of eating bouts. For the two 30 min normal speed recordings the following variables were measured: number of pecks/gm food consumed; number and duration of feeding bouts; number and duration of drinking bouts and number of nipple pecks. Two separate bouts of behaviour were recorded if they were separated by a pause of at least 5 sec duration. Base SAS software (SAS Institute, 1988) was used to perform an analysis of variance (by GLM procedure) to examine the effects of beak condition on food intake and behaviour. Duncan's Multiple Range Test was used to separate the treatment means.

Results

Length of beak and food intake: Beak type and diet both significantly ($P<0.05$) affected food intake but there were no significant interactions. Over the 7 week period S birds consumed significantly less ($P<0.05$) food than L birds (Table 4). D birds feed intake were intermediate to the L and S treatment.

Food intake on diets: Birds switched from a mash diet (week 1) to a mixed whole grain diet (week 2) suffered a significant ($P<0.05$) drop in food intake (Table 3) while birds changed from the maize and wheat diet to the sorghum and wheat diet had a significant ($P<0.05$) increase in food intake.

Particle size: No significant differences between the treatment groups could be detected in the consumption of different sizes of food particles although L birds tended to consume larger particles than the other treatment birds (Table 4).

Feeding behaviour: Time lapse records showed that the feeding rate (mg food/sec) of the D birds was significantly less ($P<0.05$) than the S birds with the L birds intermediate. Food intake over the 16 h period was not significantly different among the 3 treatments (Table 5). While few feeding behaviour variables were significantly different between beak types (Table 5), D birds tended to engage in more feeding bouts than L and S birds and spent

Table 1: Composition of layer diets (%)

Diet	1	2	3	4	5
Ingredients	Mash	Sorghum and wheat	Sorghum, wheat and canola	Sorghum, wheat and sunflower	Maize and wheat
Sorghum	42.0	42.0	33.35	31.5	-
Maize	-	-	-	-	45.0
Wheat	31.6	25.0	24.0	21.0	21.6
Soya	10.0	12.6	7.3	11.4	13.8
Sunflower	-	3.3	4.5	-	3.3
Canola	-	-	15.0	-	-
Sunflower seed	-	-	-	20.0	-
Meat and bone meal	6.8	7.0	7.0	7.0	7.5
Limestone chips	7.8	7.1	7.1	7.1	7.1
Crushed limestone	1.2	1.1	1.1	1.2	0.96
Dicalcic phosphate	-	0.34	0.09	0.2	0.17
Salt	0.25	0.25	0.25	0.25	0.25
Sunflower oil	-	0.90	-	-	-
Methionine+Lysine	0.09	0.15	0.05	0.09	0.06
Premix	0.26	0.26	0.26	0.26	0.26
Total	100	100	100	100	100

Table 2: Particle size of layer diets (%)

Diet	Particle size (%)		
	< 1 mm	1-2 mm	> 2 mm
Mash control	39.9	57.2	2.9
Sorghum and wheat	14.0	26.6	59.4
Sorghum, wheat and canola	27.5	38.9	33.6
Sorghum, wheat and sunflower	19.1	24.4	56.5
Maize and wheat	15.4	24.1	60.5

Table 3: Effect of weekly changes of diet on food intake

Diet	Week of feeding	Food intake (g/bird/day)
Mash	1	111.9^{a}
Mix of diets	2	89.3^{bc}
Sorghum, wheat and canola	3	92.1^{bc}
Sorghum, wheat and sunflower	4	82.2^{cd}
Maize and wheat	5	90.9^{bc}
Sorghum and wheat	6	74.6^{d}
Sorghum and wheat	7	103.0^{a}
LSD (P=0.05)		13.9

Means within column with different superscripts are significantly different ($P<0.05$).

more time feeding. The treatment by time of day analysis (for normal speed video records) showed that food intake, feeding time, feeding rate and food bouts were significantly higher ($P<0.05$) in the first half-hour compared to the second. There was, however, no interaction of beak type with feeding time and therefore the results (Table 6) for the 2 feeding times were pooled. The only significant effect for beak type concerned pecks at the water nipple with S birds making significantly ($P<0.05$) more pecks than D birds, while the L birds were intermediate to the S and D treatments (Table 6).

Discussion

These studies have shown that the amount of beak removed from layers has important implications for producers and researchers as well as welfare implications for the birds. In particular the behaviour of the S birds was of interest. S birds had a significantly lower food intake over all grain diets compared to L birds. It is likely that S birds have greater difficulty picking up grains, perhaps leading to frustration and a reduced food intake. L birds tended to consume larger particles than S birds, suggesting the latter had difficulty in picking up larger particles. S birds showed only a doubling of their feeding rate (mg/sec) in a post-deprivation situation compared to the *ad libitum* situation. In comparison D birds consumed feed 3½ times faster and L birds 4 times faster in the same situation. S birds were the most inefficient feeders in a post-deprivation situation showing a marked trend to make more pecks than D and L birds per gram of intake. These findings indicate that birds with short beaks and divided beaks have reduced ability to pick up food supporting earlier work showing a reduction in feed intake (Glatz and Lunam, 1994) and pecking efficiency (Gentle *et al.*, 1982) perhaps as a result of impaired temperature and touch responses (Gentle, 1986b).

These findings also indicate that S birds might be affected adversely when fed free choice or whole grain diets. They might not be able to eat enough large particles to achieve their full production potential. Further, if they are changed from one diet to another during lay, there is likely to be a drop in food intake and subsequent drop in egg numbers and egg weight.

S birds made many more pecks than D or L birds,

Table 4: Particle size intake of hens with different beak condition averaged for all diets

Beak Condition	Intake for particles < 1 mm (g/bird/week)	Intake for particles 1-2 mm (g/bird/week)	Intake for particles > 2 mm (g/bird/week)	Total feed intake (g/bird/week)
Long	198	198	350	746[a]
Divided	205	195	321	721[a]
Short	190	186	316	692[b]
LSD (P=0.05)	NS	NS	NS	27

Means within columns with different superscripts are significantly different (P<0.05). NS = not significant.

Table 5: Food intake and feeding behaviour over 15 h period of hens with different beak condition consuming the sorghum and wheat diet

Beak condition	Food intake (g)	Feeding time (sec)	Feeding rate (mg/sec)	Feeding bouts
Long	100.9	20681	5.01[ab]	234.5
Divided	101.0	24864	4.03[a]	303.0
Short	98.0	18650	5.28[b]	225.5
LSD (P=0.05)	NS	NS	1.19	NS

Means within columns with different superscripts are significantly different (P<0.05). NS = not significant.

Table 6: Food intake and feeding behaviour averaged over two 30 min periods for hens with different beak condition consuming the sorghum and wheat diet

Beak condition	Food intake (g)	Feeding time (sec)	Feeding rate (mg/sec)	Feeding bouts	Nipple pecks	Feed pecks/g
Long	11.5	771.1	21.6[b]	14.7	19.9[ab]	333
Divided	11.6	849.5	14.1[a]	19.6	10.9[b]	195
Short	10.4	937.4	10.6[a]	15.8	39.3[a]	509
LSD (P=0.05)	NS	NS	5.9	NS	20.8	NS

Means within columns with different superscripts are significantly different (P<0.05). NS = not significant.

following mild deprivation to consume a similar amount of feed in a similar time. This greater energy expenditure may have an adverse production effect especially in commercial situations with automatic feeders dispensing small quantities of feed a number of times a day. Further, feed levels in such feeding situations are permanently very low, compared to the situation in this experiment where about 8 cm depth of feed was provided. Low levels of feed in the trough might further reduce the feeding efficiency of S birds since our casual observations suggest they scoop up feed with the lower beak rather than grasp it with both beaks. Gentle *et al.* (1982) and Duncan *et al.* (1989) also report a reduction of pecking efficiency in beak trimmed birds. Beak trimming may alter the sensory perception of the bird (Gentle *et al.*, 1982) while neuromas are in the process of resolving (Lunam *et al.*, 1996). Glatz *et al.* (1998) also showed that beak trimmed birds tended to have more feed pecks per gram of food consumed and more pecks at the feeder (P<0.1) then control birds at 10 weeks. Tanaka and Yashimoto (1985) observed many feed pecks made by laying hens are without the actual intent to eat. They regarded all pecks at food without eating as play. The increase in play eating after beak trimming may possibly be explained as a result of phantom sensations or due to increased stimulation of the beak. It is also possible that beak trimming may reduce the ability of the pullet to pick up food as was found in other studies (Workman and Rogers, 1990).

S birds made significantly more pecks at the water nipples than D birds during the post-deprivation observations. Both groups consumed very similar amounts of feed during this time although the S birds made more pecks to ingest it. In the absence of water consumption data we can only speculate whether the increased nipple pecking of the S birds reflect reduced pecking efficiency or increased thirst when compared to the other groups.

In the meantime, producers and researchers should be mindful of the delicate balance between trimming which is not adequate to minimize the effects of feather picking and trimming which is so severe that it may adversely affect birds feeding and drinking abilities. In Australia this has resulted in the Australian State and Territory Agriculture Ministers recommending the development of a national beak trimming accreditation program (Glatz *et al.*, 2002) to enable industry to achieve a consistent, high quality standard of beak trimming. The standards for beak trimming (Bourke *et al.*, 2002) are based on national competency standards, which are statements of the skills required for effective performance in an industry. The findings here indicate some of the benefits, which could result from such programs to improve the consistency of beak trimming.

For research workers measuring feed intake and production, particularly if whole grain diets are involved, the implications of the severity and evenness of the beak trimming of the birds used is obvious. Murphy and Preston (1988) and Preston and Murphy (1988) have pointed out the confounding roles that feed space and feed availability could have in meat chicken nutrition trials and the same cautionary note is made here regarding potential effects of beak trimming on layer research.

Finally, while beak trimming is done to enhance bird welfare by reducing the likelihood of pecking damage, potential adverse affects on welfare have been implicated in this study in the form of impaired ability to feed and possibly to operate water nipples - both of which may lead to frustration.

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