



Morphologically abnormal beaks observed in chickens that were beak-trimmed at young ages

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ABSTRACT. A survey of beak morphological abnormalities was performed on 6,201 chickens (egg-laying hens and chickens for meat production belonging to 25 flocks) brought to a poultry processing plant. The observed abnormalities varied among flocks with occurrence rates ranging from 0.48 to 46.67%. The occurrence was high in flocks subjected to beak trimming and varied significantly according to chicken breed, with the highest rates of abnormalities in a certain chicken breed. The most widely observed abnormalities were: 1) uneven growth of the upper and lower mandibles, mostly with elongation of the lower mandible (accounting for 64.8% of all abnormalities); 2) misalignment of the upper and lower mandibles, causing lateral deviation or crossing (16.3%); 3) sharp or jagged deformities of the mandible tips (10.1%); 4) permanent open beak, a deformity in which the beak did not close completely even when closed (5.8%); and 5) formation of tubercular swellings at the tips of the upper or lower mandibles (3.1%). This is the first report on the occurrence of beak abnormalities in beak-trimmed poultry in Japan.

KEY WORDS: beak trimming, cannibalism, laying hen, mandible

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Beak trimming has long been practiced on poultry, mainly on egg-laying hens, to prevent injurious feather and vent pecking (cannibalism) and/or to reduce the spilling of feed [2, 8, 12, 19, 20, 25]. The practice was called “debeak” or “debeaking”, but the term “beak trimming” has become more widely used since the practice does not involve the removal of the entire beak, but only the tips of the beak. Beak trimming sometimes causes reduced feed intake and/or slow weight growth rates [4, 6, 10, 18, 37] but the birds usually recover as they age in days.

On the other hand, the practice of beak trimming has recently been debated from an animal welfare perspective as it causes pain and stress to the birds [2, 8, 9, 13, 25, 28, 38]. Beak trimming is banned in some EU nations, such as Finland and Sweden, but is allowed for chicks up to 10-days of age in many other countries because of its advantages [7]. In Japan, beak trimming is permitted to prevent the large-scale mortal damage caused by pecking, while also giving consideration to animal welfare [26]. According to a nation-wide survey by the Japan Livestock Technology Association in 2014, beak trimming is carried out on 83.7% of all egg-laying hens [27]. Meat chickens, which are raised in open spaces and require short periods to reach slaughter-weight, are not beak trimmed, but there are farms that carry out beak trimming on broiler breeding chickens.

Outside Japan, beak trimming of turkeys [1, 21, 32, 34, 36], guinea fowl [33], and ducks [22] has also been reported.

Of various beak trimming methods, the most common ones involve removing the distal 1/3 of the beak or leaving at least 2 mm from the nostrils, by using a hot blade (hot blade beak trimming) or infrared (infrared beak trimming) [2, 20]. Beak trimming is carried out at various ages but usually not later than 10 days after hatching, because trimming at younger ages imposes less adverse effects on feed intake [18, 19]. Re-trimming is sometimes carried out at 6 to 15 weeks [3, 5, 10, 11, 23]. A considerable level of proficiency is required to perform beak trimming appropriately at the correct position.

Beak-trimmed chickens are prone to uneven growth of the upper and lower mandibles, deformation of the beak tip, and abnormal beak occlusion as they age. These abnormal beak morphologies occur in laying hens and broiler breeding chickens that were beak-trimmed at young ages. However, such abnormalities have rarely been reported. Therefore, we surveyed the occurrence of morphologically abnormal beaks, mainly in egg-laying hens and broiler breeding chickens, brought into a poultry processing plant.

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Table 1. Occurrences of birds with morphologically abnormal beaks in 6,201 birds from 25 flocks

Chicken Flock	District of flock (Pref.)	Chicken				Beak		
		Use	Breed ^{a)}	Age	BT ^{b)}	No. observed	No. abnormal	(%)
A	Nagasaki	Layer	BB	570	Yes	230	105	(45.65)
B	Kumamoto	Layer	LSL-L	705	Yes	300	44	(14.67)
C	Miyazaki	Layer	LSL	714	Yes	210	32	(15.24)
D	Miyazaki	Layer	LSL-L	718	Yes	200	19	(9.50)
E	Miyazaki	Layer	BB	741	Yes	230	32	(13.91)
F	Kagoshima	Layer	BB	589	Yes	120	56	(46.67)
G	Kagoshima	Layer	BB	700	Yes	189	38	(20.11)
H	Kagoshima	Layer	DeB	700	Yes	230	21	(9.13)
I	Kagoshima	Layer	LSL	756	Yes	230	10	(4.35)
J	Hiroshima	Layer	LSL-L	695	Yes	470	35	(7.45)
K	Fukuoka	Layer	LSL-L	714	Yes	220	15	(6.82)
L	Okayama	Layer	LSL	722	Yes	230	25	(10.87)
M	Kagawa	Layer	LSL	740	Yes	310	35	(11.29)
N	Ehime	Layer	HL W36	758	Yes	300	51	(17.00)
O	Iwate	Br-PS ^{c)}	R 308	455	Yes	250	6	(2.40)
P	Iwate	Br-PS	R 308	442	Yes	210	34	(16.19)
Q	Iwate	Br-PS	R 308	486	Yes	210	9	(4.29)
R	Miyazaki	Br-PS	R 308	445	Yes	300	26	(8.67)
S	Okayama	Br-PS	R 308	462	Yes	470	20	(4.26)
T	Miyazaki	Br-PS	R 308	443	No	210	1	(0.48)
U	Miyazaki	Br-PS	R 308	462	No	262	2	(0.76)
V	Kagoshima	Br-PS	R 308	449	No	230	2	(0.87)
W	Iwate	Br-PS	R 308	457	No	210	2	(0.95)
X	Tokushima	Br-PS	R 308	462	No	250	3	(1.20)
Y	Kagoshima	Meat-type chicken	Satsuma	105	Yes	130	21	(16.15)
Total						6,201	644	(10.38)

a) BB: Boris Brown, DeB: Dekalb Brown, HL W36: Hy-Line W-36, LSL: Lohmann LSL-Classic, LSL-L: Lohmann LSL-Lite, R 308: Ross 308, Satsuma: Satsumadori. b) BT:Beak-trimming. c) Br-PS: Broiler Parent Stock.

MATERIALS AND METHODS

Chickens and survey

The survey was conducted at a processing plant of Enuchicken Co., Ltd., located in Chiran, Minamikyushu City, Kagoshima Prefecture. Approximately 8 million chickens are annually brought into the plant from various districts of Japan, including spent hens, i.e. aged egg-laying hens or broiler breeding hens. Between August 2014 and May 2015, we conducted 5 inspections, surveying a total of 6,201 chickens belonging to 25 flocks. As shown in Table 1, the chickens were brought from 11 prefectures of Japan. All laying hens (14 flocks) were beak-trimmed, 5 out of 10 broiler breeding flocks were beak-trimmed, and the remaining 5 flocks were not beak-trimmed. We examined one flock free-range broiler chickens that had been beak-trimmed.

As shown in Table 1, all but free-range chickens (Flock Y) were over 442 days old when they were brought into the plant. The birds in the Flock Y were 105 days old. Details of beak trimming, such as the ages of the chickens when were beak-trimmed, the methods used (such as the models of the debeaker machines), and practitioner skill levels, differed by flock and are unknown.

On the way to processing, at least 200 heads per flock were randomly sampled and those that showed beak abnormalities were selected. The selected heads were brought into the laboratory and the beak morphologies were examined in detail. For individuals that showed two or more abnormalities, the abnormalities were recorded separately.

Statistical analysis

A chi-square (χ^2) test was used for statistical comparisons of the results between pairs of flocks.

RESULTS

Beak abnormalities and their occurrences

Beak abnormalities were observed in all 25 flocks examined, including flocks that had not been beak-trimmed. As shown in Table 1, the occurrence of abnormalities varied among flocks, ranging from 0.48 to 46.67%. Examples of a normal beak (Fig. 1a) and observed abnormalities, including misalignments, are shown in Fig. 1. Beak abnormalities were classified into 5 categories: 1) uneven growth of the upper and lower mandibles, 2) misalignment of the upper and lower mandibles (lateral deviation or crossing), 3) deformities at the mandible tip (sharp or jagged mandible), 4) permanent open beak, and 5) tubercular swelling formation. The

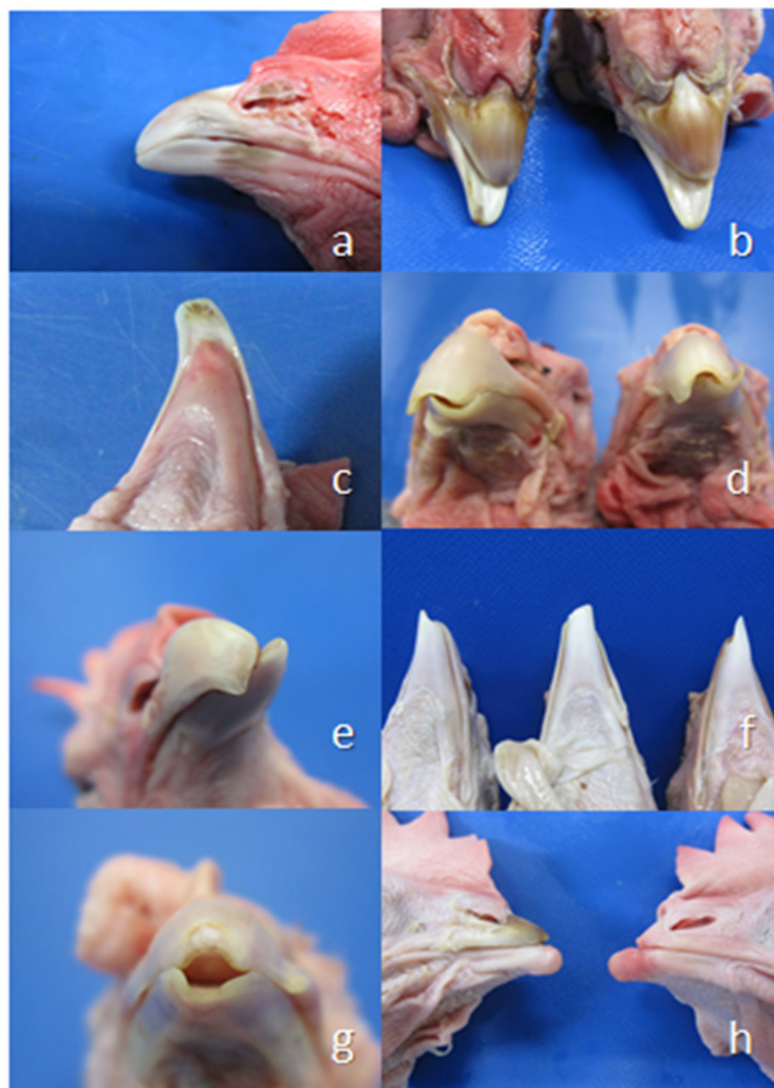


Fig. 1. Examples of morphologically abnormal beaks observed in chickens at a processing plant in Kagoshima. a: a normal beak; b: uneven growth resulting in a longer lower mandibles; c: uneven growth resulting in a longer upper mandibles; d: beaks showing abnormal occlusion; e: a beak with crossed mandibles; f: sharp edged mandibles; g: permanent open beak; h: tubercular swellings at the tips of the lower mandibles.

Table 2. Percentages of morphological abnormalities in chicken beaks

Abnormality	No. observed	(%)
1) Uneven growth of the upper and lower mandibles	502	(64.8)
2) Misalignment of the mandibles	126	(16.3)
3) Deformities at the mandible tips	78	(10.1)
4) Permanent open beak	45	(5.8)
5) Tubercular swelling	24	(3.1)
Total	775	(100)

percentages of observed abnormalities within each category are shown in Table 2. The most widely observed abnormality was 1) uneven growth of the upper and lower mandibles, which accounted for 64.8% of all abnormalities and was mainly (in 92% of cases) caused by overgrowth of the lower mandible. This was followed by 2) misalignment of the mandibles, which accounted for 16.3% of the total and involved abnormal beak occlusion caused by lateral deviation of the upper and lower mandibles and crossing of the mandibles. The third common abnormality was 3) sharply or jaggedly deformed mandible tips, accounting for 10.1% of the total. We also observed cases of 4) permanent open beak, in which the beak did not close completely (5.8%) and 5) tubercular swelling formations at the mandible tips. These swellings never occurred on both the upper and lower mandibles, but on either the upper or lower mandible.

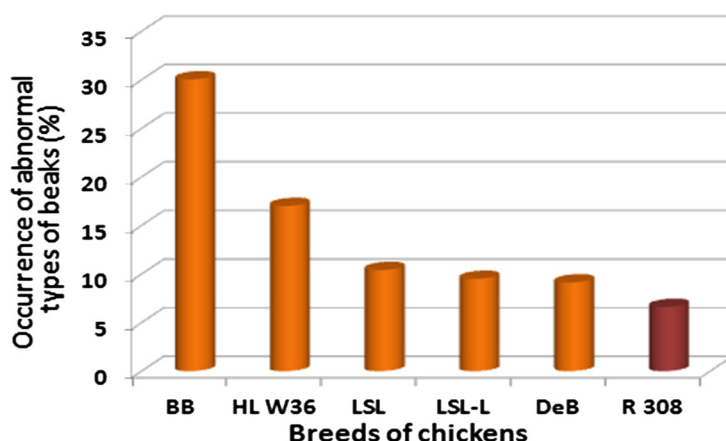


Fig. 2. Occurrence (%) of abnormal types of beaks observed in 6 breeds of chickens treated with beak trimming. BB: Boris Brown, DeB: Dekalb Brown, HL W36: Hy-Line W-36, LSL: Lohmann LSL-Classic, LSL-L: Lohmann LSL-Lite, R 308: Ross 308.

Occurrence in each egg-laying and breeding brand

Seven breeds of chicken were included in this study: Five egg-laying breeds (accounting for 3,768 hens) and 2 meat-type chicken breeds. Of the age-matured meat-type chicken breeding chickens, about half (1,440 chickens) were beak-trimmed, and all of these were Ross 308 (R 308). The occurrence of abnormalities in each of the 5 egg-laying breeds and the beak-trimmed R 308 chickens is summarized in Fig. 2. The occurrence was highest in Boris Brown (BB), with 30.04% of chickens showing abnormalities, and this was followed by Hy-Line W-36 (HL W36), with 17.00%. The R 308 breed showed the lowest occurrence, with 6.6% of beak-trimmed chickens showing abnormalities. The occurrence of abnormalities in the entire beak-trimmed group was 13.75%. On the other hand, the occurrence in 5 flocks that were not beak-trimmed, which were all R 308, was only 0.86%. Significant statistical differences ($P < 0.05$) were found between BB and HL W36, between HL W36 and Lohmann LSL-Classic (LSL), between Lohmann LSL-Lite (LSL-L) and Dekalb Brown (DeB), and between the beak-trimmed and non-beak-trimmed R 308 flocks. Differences among LSL, LSL-L and DeB were not significant.

We also examined a flock of 105-day-old Satsumadori (Satuma) meat-type chickens that had been beak-trimmed. The occurrence of abnormalities in this flock was 16.15% (Table 1).

Relationship with age

The ages of the flocks investigated were 105 days, 442–486 days and 570–758 days, as shown in Table 1. Excluding two flocks of BB, there were no major trends in the occurrence of morphological beak abnormalities among the age groups.

DISCUSSION

The objective of this survey was to analyze the types and occurrences of beak abnormalities in beak-trimmed chickens in Japan. Our observations of age-matured egg-laying and meat-type chicken breeding chickens brought into a processing plant revealed high occurrence of beak abnormalities. Such morphological abnormalities have been observed by people involved in the poultry industry, but there have been no scientific reports describing them. Our present report is the first detailed survey of these abnormalities.

We classified the beak abnormalities observed in this survey into 5 categories: elongation of the lower or upper mandible, misalignment of the mandibles, deformities of mandible tips, open beak and tubercular swelling at the mandible tips. Elongation of the lower mandible accounted for a large percentage of the total. Although individual measurements are not shown, there was one prominent case in which the lower mandible was 8 mm longer than the upper mandible. There have been several reports of elongation of the lower mandible compared to the upper mandible after beak-trimming, with average differences of 1.5 to 3.9 mm on average [10, 29, 35]. The causes of the differences in mandible growth have not been revealed, however, differences in the position and angle of trimming may be involved. Another interesting question is whether having a longer lower mandible or a longer upper mandible is preferable for the chicken in terms of feed intake.

There have been no other reports on the misalignment of mandibles, and again, the cause is unknown. Misalignment is caused by either or both of the mandibles diverging sideways, either to the right or the left. We observed no major bias toward either side. We also observed cases in which the mandibles crossed each other completely, but the cause is unknown.

Mandible tip deformities included sharpened and jagged beak tips. Sharpened mandible tips are more likely to cause serious injuries to other chickens when pecked.

The open beak abnormality may result from excessive trimming of the beak, and may inhibit the sufficient intake of feed.

The most infrequent type of beak abnormality was tubercular swelling of the upper or lower mandible tip. These swellings

formed at similar rates on the upper and lower mandibles, but almost no single bird showed development of both. Interestingly, the mandible on which the swelling occurred tended to be consistent within each flock. This is suggesting that the cause was some aspect of the beak-trimming technique and/or method. The formation of neuromas in the beaks of beak-trimmed chickens has been reported outside Japan [15, 16, 29]. We performed a histologic examination and found that the swelling consisted of a keratinized cuticle on the surface with cancellous tissue, fibrous connective tissue and aggregations of peripheral nerves within (unpublished). The aggregation of peripheral nerves was likely to be a reactive hyperplasia due to the injury of a peripheral nerve during the beak trimming process. Therefore, the swellings observed in this study were unlikely to be neuromas.

The occurrence of beak abnormalities varied among flocks and was highly dependent on chicken breed. The occurrence was especially high in Br, a breed of brown egg-laying chickens. According to the information from farmers, this tendency has been recognized somehow since long before in poultry farms. Extra care should be taken when beak trimming is done for such breeds.

Beak abnormalities were also observed in relatively young (105-day-old) broiler chickens. Selection and exclusion of individuals showing severe beak abnormalities is possible upon transfer from a rearing house to a henhouse. For that reason, it would be useful to investigate how long it takes after beak trimming for abnormalities to be apparent.

The beak abnormalities observed in this survey were easy to discriminate. The birds that had such abnormalities were likely to have grown at satisfactory rates, however, their egg laying performance is questionable and unknown. Beak abnormalities may impede feed and/or water intake. The chicken beak is also known to play an important role in grooming and removal of external parasites [2, 19, 31, 38]. For these reasons, it is important to further investigate the impacts of beak abnormalities on the subsequent growth and development of the birds.

In Japan, the most widely-used technique for beak-trimming is the hot blade method. Infrared beak-trimming developed abroad is a milder technique that results in lower rates of weight loss and beak abnormalities after treatment [14, 17, 20, 24, 30], and this method is spreading, even though gradually, in Japan. From the animal welfare perspective, and in order to optimize chicken and egg production, cautious attention should be paid to the effects of beak-trimming in both the short-term and long-term periods after treatment.

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