The influence of contact with humans on bird-to-bird pecking, fear-related behaviour, stress response, and growth in commercial broiler chickens and red jungle fowl when reared separately or intermingled

Einfluss des menschlichen Kontaktes auf gegenseitiges Bepicken, Furcht bezogenes Verhalten, Stressreaktion und Wachstum von kommerziellen Broilern und Roten Dschungelhühnern bei separater oder gemeinsamer Aufzucht

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Introduction

According to Jones (1996), fear is an emotional (psychophysiological) response to perceived danger. High levels of fear not only represent a state of suffering, but that it is also a powerful and potentially damaging stressor. The predominant response of domestic fowl to humans is thought to be one of fear (Jones, 1996). Naïve chickens may perceive contact with humans as an alarming predatory encounter (Suárez and Gallup, 1981). Earlier studies showed that heightened fearfulness is not only detrimental to growth and reproductive performance but may also influence feather pecking and cannibalism in poultry (Choudary et al., 1972; Vestergaard et al., 1993; Campo et al., 2001). Literature regarding the relationship between feather pecking and underlying fearfulness is conflicting. Previous evidence suggested that fearfulness and feather pecking were positively associated. Feather loss has been reported to be more pronounced in fearful than in less nervous flocks (Choudary et al., 1972; Orpoho et al., 1987). Hughes and Duncan (1972) reported that birds with the least pecking damage had the lowest fear scores, whereas the severely pecked hens in cages were the most fearful. On the other hand, working with Spanish breeds of chickens, Campo et al. (2001) found that very poorly feathered hens were less fearful. Jones et al. (2004) suggested that the relationship between feather pecking and fearfulness is extremely labile and that increased fear is more likely to be an effect of feather pecking than a cause. Studies on harmful social behaviour (Zulkifli et al., 1998) and underlying fearfulness (Zulkifli et al., 1999) in commercial broilers and jungle fowl indicated higher frequency of bird-to-bird pecking and longer tonic immobility fear reactions in the latter.

The quality of human-animal interaction can have profound effect on many facets of an animal’s physiology and behaviour (Hemsworth and Gonyou, 1997). Regular pleasant human contact not only reduce underlying and physiological stress response in poultry (Zulkifli et al., 2002; Zulkifli and Siti Nor Azah, 2004) but also reduce incidence of aggressive interactions within flocks (Collins and Siegel, 1987). While there has been substantial work on the effect of regular contacts with human beings on welfare and performance of broilers and laying hens (Jones, 1996; Hemsworth and Gonyou, 1997), there is a dearth of information on human contact on behaviour, fear and stress reactions, and growth in jungle fowl. In prey animals like the jungle fowl, the ancestor of the domesticated bird, there is a high evolutionary pressure for anti-predator behaviour, such as tendency to death feign or to show tonic immobility (Gallup, 1977).

Most research on intermingling of chicks of diverse genetic background has emphasized on ingestive behaviour. Little information is available on the effect of such environment on the welfare of the birds. The present study evaluated the effects of regular physical and visual contacts with human beings on bird-to-bird pecking and fear-related behaviour, stress response and growth in commercial broilers (CB) and jungle fowl (JF) raised from hatching as separate and intermingled flocks. Zulkifli et al. (1998) showed that JF reared intermingled directed high levels of “damaging” pecking towards their CB counterparts resulting in physiological stress responses in the latter.

Materials and methods

Birds and husbandry

Male and female red jungle fowl and commercial broilers (Arbor Acres) were used in the study. The JF breeding stock was originally captured from the secondary forests and oil palm plantations in peninsular Malaysia and was assumed to be genetically pure. Purity of the JF were assessed by gross characteristics, namely the shape and size of the bird, colour of the plumage, colour of the shank, and ear lobes, pattern of arrangements of the tail feathers, and the size and thickness of the comb (Vidyadaran, 1987). The stock was maintained as a closed flock at Universiti Putra Malaysia.
At hatch all chicks (n = 540) were wing banded and weighed to the nearest g. Chicks were raised in floor pens with deep litter of wood shavings as litter. The pens were in a conventional open-sided house with cyclic temperatures (minimum, 24°C; maximum 34°C). The area of each pen was 5.21 m² and contained one automatic bell drinker and two tube feeders. To reduce visual contact with humans and other flocks, opaque partitions (1.5 m high) were erected between adjacent and opposite pens. The feed supply was changed from starter (2,950 kcal ME/kg; 21% crude protein) to finisher (3,050 kcal ME/kg; 19% crude protein) at 21 days of age. Birds were reared under constant light with feed in mash form and water available ad libitum. Chicks were administered Newcastle disease vaccine via drinking water on day 7 and day 21.

**Treatment groups**

On day 0, chicks were randomly assigned to 27 floor pens: nine with CB (20 birds/pen), nine with JF (20 birds/pen) and nine where chicks from two genotypes were intermingled (5 CB and 5 JF/pen). From day 1 to day 21, three pens of chicks of each flock were randomly assigned to one of the three treatments. First, non-handled controls received no physical or visual contact with humans other than the routine husbandry (control). Second, chicks in the physical contact group were picked up individually and stroked gently for 30 s once daily in their home pen (PC). Third, a chick in the visual contact group was randomly caught, picked up and stroked gently for 10 min twice daily in its home pen to allow other birds in the flock to view the procedure (VC). The same experimenter who always wore a white laboratory coat conducted all the human contact procedures. The tonic immobility (TI) test and blood sampling were done by other experimenters who also wore white laboratory coats. Birds that had been habituated to one person by a regimen of regular human contact showed less fear to other people that were similarly dressed (JONES, 1995).

**Recording of behaviour**

On day 34 (from 0900 h to 1100 h) and 41 (from 0900 h to 1100 h), the number of chicks bird-to-bird pecking was observed every one minute for five minutes following a two minute period for the birds to adjust to the presence of the observer. Two pens were observed by two different experimenters simultaneously. As for the intermingled flock, data were obtained for each genotype. The definition of bird-to-bird pecking comprised of feather pecking without removal, feather pulling leading to feather loss, tissue pecking in denuded areas and vent pecking (SAVORY, 1995).

**Tonic immobility test**

On day 42, five chicks (randomly selected) from each pen (except for the intermingled flocks) were individually removed and carried to a separate room and used for tonic immobility (TI) measurements. Where genotypes were intermingled, TI was measured for each genotype (5 CB and 5 JF). Hence, the total number of birds subjected to TI test was 135. TI was induced as soon as the birds were caught by gently restraining them on the right side by the legs and wings for 15 s (Zulkifli, 2003). The experimenter then retreated approximately 1 m and remained within sight of the bird but made no unnecessary noise or movement. A stopwatch was started to record latencies until the bird righted itself. If the bird righted in less than 10 s, it was captured again and the restraining procedure was repeated. If TI was not induced after three trials the duration of TI was as 0 s. The maximum duration of TI allowed was 900 s. The number of inductions required to attain TI was recorded.

**Blood collection and analysis of samples**

On day 42, five birds from each pen (except for the intermingled flock) that were not measured for TI duration were individually, gently removed with minimum disturbance to flock mates. Where genotypes were intermingled, blood samples were collected from each genotype (5 CB and 5 JF). Hence, the total number of birds bled was 135. Immediately following capture their blood samples were collected by puncturing the vena ulnaris for plasma corticosterone concentration assay (heparin, anticoagulant), and heterophils to lymphocyte counts (EDTA, anticoagulant). The procedure did not exceed 45 s. Plasma samples were stored at -20°C until assayed. Plasma corticosterone concentration was measured using a sensitive and highly specific radioimmunoassay kit (MP Biomedicals, CA). Blood smears were prepared using May-Grunwald-Giemsa stain and heterophils and lymphocytes were counted to a total of 60 cells (GROSS and SIGEL, 1983).

**Statistical analyses**

All analyses were conducted with the aid of General Linear Model procedure of SAS® software (SAS INSTITUTE, 1997). The bird-to-bird pecking data which were expressed as percentages were transformed to the arc sine square roots of the ratio of chicks performing the behaviour. The data for duration of TI and HLR were normalised using a logarithmic and square root transformation, respectively prior to analysis. All data were subjected to three-way ANOVAs with the statistical model

\[
Y_{ijkl} = \mu + G_i + F_j + H_k + (GF)_{ij} + (GH)_{ik} + (FH)_{jk} + (GFH)_{ijk} + \varepsilon_{ijkl}
\]

Where \(Y_{ijkl}\) = analysed response; \(\mu\) = the overall mean; \(G_i\) = the fixed effect of genotype \(i (1, 2)\); \(F_j\) = the fixed effect of flock type \(j (1, 2)\); \(H_k\) = the fixed effect of human contact \(k (1, 2)\); \(GF)_{ij}\), \(GH)_{ik}\), \(FH)_{jk}\), \(GFH)_{ijk}\) = the interactions; \(\varepsilon_{ijkl}\) = residual error

When interactions between main effects were significant, subclass means were first analysed. Age was also included in the model for the analysis of bird-to-bird pecking activity data. However, because age had no significant effect on the behaviour, data of both ages (day 34 and 41) were pooled for analysis. When the F test for treatments was significant at \(P < 0.05\), means were compared for significant difference using Duncan’s multiple-range test.

**Results**

The human contact x flock and the genotype x human contact x flock interactions were not significant for any measurement (Table 1). There were significant genotype x human contact interactions for body weight (\(P < 0.01\)), duration of TI (\(P < 0.05\)) and bird-to-bird pecking activity (\(P < 0.05\)) (Table 2). CB that were subjected to PC were significantly heavier than those of VC and controls. Both PC and VC, which did not differ, shortened the TI duration of CB when compared to controls. However, among the JF, those subjected to PC had the shortest TI followed by VC and controls. In the three human contact treatments, CB showed lower frequency of damaging pecking than JF after controls. While human contact had no significant effect on
bird-to-bird pecking activity among CB, both PC and VC significantly reduced the percentages of JF birds showing the behaviour. Irrespective of genotype and flock type, PC and VC significantly reduced (P < 0.05) plasma levels of corticosterone (3.86 and 3.41) and HLR (0.39 and 0.41) when compared to controls (6.65 and 0.39, respectively). No significant human contact x genotype and human contact x flock type interactions with both main effects.

Genotype x flock interactions were significant for body weight, plasma corticosterone, HLR and bid-to-bird pecking activity (Table 3). Intermingling depressed the body weights of CB but not those of JF. While genotype had negligible effect among the separated flocks, the plasma corticosterone concentration and HLR of the intermingled CB were significantly elevated. In both flock types, CB showed low frequency of “damaging” pecking. Intermin-

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Table 1. Effects of genotype, human contact and flock type on body weight, bird-to-bird pecking, tonic immobility (TI) duration, plasma corticosterone concentration and heterophil/lymphocyte ratio (HLR) (Mean ± SEM)

<table>
<thead>
<tr>
<th>Item</th>
<th>Body weight (g) (day 42)</th>
<th>Bird-to-bird pecking (%)</th>
<th>TI duration (s)</th>
<th>Plasma corticosterone concentration (ng/ml)</th>
<th>HLR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genotype</td>
<td></td>
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</tr>
<tr>
<td>CB</td>
<td>1.660 ± 31.9</td>
<td>0.16 ± 0.03</td>
<td>148 ± 20.7</td>
<td>5.39 ± 0.81</td>
<td>0.49 ± 0.03</td>
</tr>
<tr>
<td>JF</td>
<td>184 ± 3.8</td>
<td>10.83 ± 2.83</td>
<td>803 ± 11.1</td>
<td>3.83 ± 1.68</td>
<td>0.40 ± 0.04</td>
</tr>
<tr>
<td>Human contact</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>PC</td>
<td>991 ± 98.9</td>
<td>3.86 ± 0.62</td>
<td>422 ± 22.9</td>
<td>3.86 ± 1.39</td>
<td>0.39 ± 0.04</td>
</tr>
<tr>
<td>VC</td>
<td>901 ± 122.9</td>
<td>4.17 ± 0.21</td>
<td>474 ± 19.7</td>
<td>3.41 ± 1.78</td>
<td>0.41 ± 0.05</td>
</tr>
<tr>
<td>Control</td>
<td>890 ± 114.9</td>
<td>6.92 ± 1.33</td>
<td>532 ± 20.5</td>
<td>6.65 ± 1.61</td>
<td>0.53 ± 0.04</td>
</tr>
<tr>
<td>Flock type</td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>S</td>
<td>1.056 ± 108.2</td>
<td>2.13 ± 0.21</td>
<td>434 ± 19.7</td>
<td>3.57 ± 1.34</td>
<td>0.20 ± 0.05</td>
</tr>
<tr>
<td>I</td>
<td>781 ± 78.3</td>
<td>8.87 ± 1.89</td>
<td>505 ± 16.3</td>
<td>5.65 ± 1.65</td>
<td>0.49 ± 0.03</td>
</tr>
<tr>
<td>Source of variation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Genotype</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>NS</td>
<td>NS</td>
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<tr>
<td>Human contact</td>
<td>NS</td>
<td>NS</td>
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<tr>
<td>Flock type</td>
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<td>NS</td>
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<td>Genotype x human contact</td>
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<tr>
<td>Genotype x flock type</td>
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<td>NS</td>
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<tr>
<td>Human contact x flock type</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Genotype x human contact x flock type</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

CB = commercial broilers; JF = jungle fowl; PC = physical contact; VC = visual contact; Control = ignored
S = genotype-separated; I = genotype-intermingled
* P < 0.05; ** P < 0.01; *** P < 0.001; NS = not significant

Table 2. Mean (±SEM) body weights, tonic immobility (TI) durations, bird-to-bird pecking percentages of broiler chickens for significant genotype x human contact interactions

<table>
<thead>
<tr>
<th>Human contact</th>
<th>Body weight (g)</th>
<th>TI duration (s)</th>
<th>Bird-to-bird pecking (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CB</td>
<td>JF</td>
<td>CB</td>
</tr>
<tr>
<td>PC</td>
<td>1810 ± 15.4</td>
<td>172 ± 2.32</td>
<td>137 ± 29.9</td>
</tr>
<tr>
<td>VC</td>
<td>1627 ± 12.6</td>
<td>175 ± 1.98</td>
<td>127 ± 17.6</td>
</tr>
<tr>
<td>Control</td>
<td>1598 ± 15.7</td>
<td>181 ± 4.10</td>
<td>180 ± 14.6</td>
</tr>
</tbody>
</table>

a,b Means within a column-subgroup with no common letters differ at p < 0.05.

x,y Means within a row-subgroup with no common letters differ at p < 0.05.

CB = commercial broilers; JF = jungle fowl
PC = physical contact; VC = visual contact; Control = ignored
Table 3. Mean (±SEM) body weights, heterophil to lymphocyte ratios (HLR), plasma corticosterone concentrations and bird-to-bird pecking percentages of broiler chickens for significant genotype x flock type interactions

<table>
<thead>
<tr>
<th>Flock type</th>
<th>Body weight (g)</th>
<th>Plasma corticosterone (ng/ml)</th>
<th>HLR</th>
<th>Bird-to-bird pecking (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CB</td>
<td>JF</td>
<td>CB</td>
<td>JF</td>
</tr>
<tr>
<td>S</td>
<td>1936±4</td>
<td>22.61</td>
<td>175±3.54</td>
<td>3.24±1.20</td>
</tr>
<tr>
<td>I</td>
<td>1385±4</td>
<td>15.52</td>
<td>177±4.11</td>
<td>7.53±1.31</td>
</tr>
</tbody>
</table>

*< Means within a column-subgroup with no common letters differ at p < 0.05.

** Means within a row-subgroup with no common letters differ at p < 0.05.

CB = commercial broilers; JF = jungle fowl
S = genotype-separated; I = genotype-intermingled

Discussion

Literature data are not consistent about the effects of regular handling on weight gain of chickens. Some authors reported a significant improvement in weight gain (Jones and Hughes, 1981; Gross and Siggel, 1982; Collins and Siggel, 1987), whereas others found either no effect (Reichman et al., 1978), or a negative effect (Freeman and Manning, 1979) of handling on growth. The present findings confirmed those of Zulkifi and Siti Nor Azah (2004) in commercial broiler chickens that while PC can improve body weight, VC had negligible influence on growth. The authors indicated that physical contact by humans may involve more active interaction, such as picking the bird up or stroking the bird. Gross and Siggel (1982) postulated that positive human contact reduced the resources otherwise required by the birds to respond to their human associates and that resources can be utilized for growth. The lack of significant effect of human contact on the growth of JF could be because there is little room for attainment of even greater body weights.

Results of this study concur with earlier findings (Zulkifi et al., 1998) that JF had high levels of ‘damaging’ pecking. The authors suggested that the high frequency of bird-to-bird pecking was associated with deprivation of foraging activities among the JF raised in wire-floor cages. El-Lethy et al. (2000) noted that commercial laying hens housed with straw did not show high rates of feather pecking. However, in the present study, despite the presence of wood shavings as litter materials which allowed foraging activities such as scratching and pecking, frequency of bird-to-bird pecking remained high among the JF. The discrepancies could be attributed to the type of foraging materials used. Huber-Eicher and Wechsler (1998) found that less cannibalism occurred when chicks were given long-cut straw bundled in sheaths rather short-chopped straw, and polystyrene blocks rather than polystyrene beads. It appears that foraging materials must be able to maintain sustained foraging activity to be effective in reducing cannibalism. There is a possibility that litter types such as wood shavings are relatively unattractive foraging substrates.

It is interesting to note that regardless of flock type, bird-to-bird pecking remained relatively low within the JF population itself. Zulkifi et al. (1998) postulated that CB are susceptible to be pecked because of their submissive nature attributable to intense selection for rapid growth. There is evidence that birds tend to peck those that appear different from themselves. According to Chikamune et al. (1988), when birds having different feather colour were housed together in equal numbers the dominant white plumage received more pecking injuries than birds with barred plumage. The phenomenon could be associated with the ability of birds to see structures in the plumage which are only visible under the ultraviolet light (Ruth Newberry, personal communication). The present findings are in agreement with those of Choudary et al. (1972), Vestergaard et al. (1993), and Campo et al. (2001) that fearfulness and feather-pecking behaviour are positively associated. The JF were highly susceptible to fear and directed high levels of ‘damaging’ pecking towards their CB counterparts. There is also a possibility that the relationship between fearfulness and feather pecking may be influenced by genetic background. Jones et al. (1995) studied tonic immobility fear reactions in chickens divergently selected for low or high levels of feather pecking and concluded that the association between fearfulness and feather pecking is not straightforward.

Within the intermingled flock, the high levels of bird-to-bird pecking showed by the JF was stressful to their CB counterparts, as measured by corticosterone and HLR reactions. Harmful social behaviour is potent in evoking the hypothalamic-pituitary-adrenal axis (Zulkifi and Siggel, 1995). On the contrary, working with two Spanish breeds of chickens, Black Castellana and Quail Castellana, Campo et al. (2005) reported that raising the former separately increased HLR as compared to those that were intermingled and both flock types had no influence on pecking behaviour. Thus, it appears that intermingling different breeds of chickens is not stressful unless it involves ‘damaging’ pecking. The greater HLR in CB as opposed to JF may also be attributed to the physiological demand for rapid growth in the former (Zulkifi et al., 1998). The present findings confirmed previous work (Zulkifi et al., 1999) that, as measured by TI duration, the JF were more fearful than CB. The phenomenon could be associated with the natural environment of the JF and antipredator defense behaviour (Rovee et al., 1976; 1977). Gregor (1993; as
cited by Jones, 1996) suggested that because the natural habitat of the JF is in dense forest, the birds may feel exposed to attack by predators in open areas. There is considerable evidence that TI or death feigning is an important predation defense in avian species (Rowe et al. 1976; 1977).

As measured by plasma levels of corticosterone, HLR and tonic immobility duration, the present results suggested that PC and VC have a profound influence on underlying fearfulness and physiological stress reactions in both CB and JF. This is in general agreement with earlier findings (Zulkifli et al., 2002; 2004) that positive human contact is a reliable and potent method of reducing stress and fear in poultry. Among the JF but not CB, PC appears to be more effective than VC in ameliorating underlying fearfulness. It can be concluded that there are breed or strain differences in response to human contact. Because of the close relationship between underlying fearfulness and feather pecking, the PC and VC procedures attenuated fear reaction in JF and subsequently reduced the frequency of bird-to-bird pecking towards their CB counterparts. Agonistic behaviour, which encompasses both aggressive and submissive components (Craig, 1981) is inevitable in social animals. It causes concern from both welfare and economic standpoints. Beak trimming is routinely performed in commercially reared poultry to prevent or control cannibalism and feather pecking. These findings suggest that regular physical or visual contact with human beings may offer a feasible method for reducing incidence of aggressive interactions in breeds of chickens that are highly susceptible to fear and with high propensity to feather peck.

Summary

This study investigated the effects of regular physical and visual contacts with human beings on bird-to-bird pecking behaviour, tonic immobility (TI) duration, corticosterone, heterophil to lymphocyte ratio (HLR) and growth in commercial broilers (CB) and jungle fowl (JF) raised from hatching as separate and intermingled flocks. On day 0, chicks were randomly assigned to 27 floor pens: nine with CB (20 birds/pen), nine with JF (20 birds/pen) and nine where chicks from the two genotypes were intermingled (10 CB and 10 JF/pen). The following treatments were applied (three pens per treatment) daily from day 1 to 21 to both CB and JF: (1) non-handled controls received no physical or visual contact with humans other than the routine husbandry (control), (2) each chick in the physical contact group were picked up individually, and stroked gently for 30 s once daily (PC), (3) a chick in the visual contact group was randomly caught, picked up and stroked gently for 10 min twice daily (VC). Both PC and VC treatments were done in the chicks' home pens to allow other birds in the flock to view the procedure. On day 42, CB that were raised as separate flocks had significantly greater body weights than those of intermingled flocks, similarly to CB subjected to PC in comparison with controls and VC. However, the body weights of JF were not affected by flock type or human contact. Intermingling increased bird-to-bird pecking activity in JF, and retarded body weight, elevated plasma levels of corticosterone and HLR in CB. Both PC and VC significantly reduced the incidence of harmful pecking and attenuated HLR and TI reactions in CB. Irrespective of flock type, JF, as measured by TI duration, were significantly more fearful than their CB counterparts. Regular physical contact was more effective than visual contact in ameliorating the TI reaction in JF. Regular human contact may attenuate the expression of bird-to-bird pecking and its harmful consequences.

Key words

Broiler, jungle fowl, human contact, pecking behaviour, fear, stress

Zusammenfassung

Einfluss des menschlichen Kontaktes auf gegen seitiges Bepicken, Furcht bezogenes Verhalten, Stressreaktion und Wachstum von kommerziellen Broilern und Roten Dschungelhühnern bei separater oder gemeinsamer Aufzucht


Stichworte

Broiler, Dschungelhuhn, menschlicher Kontakt, Federrückenverhalten, Furcht, Stress

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References


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