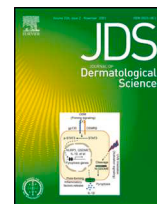




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Letter to the editor

Food allergens detected in indoor pet fur

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Dear Editor,

Children are subject to exposure to environmental factors (e.g.: microbe, tobacco smoke, viruses, and dog and cat fur) that promote the development and/or the progression of allergic diseases [1,2]. As it is increasingly recognized that multiple routes of allergen exposure could affect allergic disease phenotypes and development in children, it is important to investigate all the possible routes of allergen exposure.

Sensitization to food allergens is often observed in infants with moderate to severe atopic dermatitis, leading to the hypothesis that cutaneous exposure to food allergens might be an important sensitization mechanism [3]. Several observational studies indicated that epicutaneous exposure to environmental peanut allergens could be associated with the development of peanut sensitization [3].

The primary pathway for environmental exposure to hen's eggs or peanut allergens could be through those present in household dust [4–7]. It was previously demonstrated that egg protein and house dust mite (HDM) antigens were detectable in the dust from participants' bedsheets, which suggest that food proteins could spread throughout residential spaces [4]. However, no studies have reported on the potential environmental exposure pathways of food allergens with the exception of household dust. Thus, this study aimed to investigate whether hen's egg or peanut proteins could be detected in indoor pet fur.

Fifteen voluntary households, with at least one owned indoor cat or dog, were recruited between December 2020 and February 2021. A total of 11 and 10 samples of cat and dog fur, respectively, were collected by the participants in each recruited household using scissors, a pet comb, or hair clippers, and disposable gloves. Ethics approval was obtained from the ethics board of the National Center for Child Health and Development (Accession number 2020–200). Informed consent was obtained from the owners of all the animals from which fur samples were collected. The 17 fur samples (7 cat

and 10 dog fur samples) weighing more than 0.15 g were used for protein extraction. Hen's egg and peanut proteins and Can f 1 or Fel d 1 were extracted from the dog or cat fur samples, respectively, and were measured using enzyme-linked immunosorbent assay (ELISAs; Hen's egg: FASTKIT ELISA Ver. III hen's egg, Research & Development Center, NH Foods Ltd., Ibaraki, Japan; Peanut: FASTKIT ELISA Ver. III peanut, Research & Development Center, NH Foods Ltd., Ibaraki, Japan; Can f 1: Dog (*Canis familiaris*) Allergen ELISA Kit, Indoor Biotechnologies Inc., Charlottesville, VA, USA; Fel d 1: Cat (*Felis domesticus*) Allergen ELISA Kit, Indoor Biotechnologies Inc., Charlottesville, VA, USA). The quantification ranges were 0.25–17 µg/g pet fur for hen's egg and peanut, 0.017–5.3 µg/g pet fur for Can f 1, and 0.017–2.1 µg/g pet fur for Fel d 1. Samples with hen's egg and peanut protein levels above the range of the standard curve were further diluted. Between-group comparison of the protein levels was performed using the Mann–Whitney test.

Hen's egg proteins were detected in the extracts of all the 17 fur samples (median: 1.6 µg/g fur, range: 0.25–22.3 µg/g fur), whereas peanut proteins were found in 13 out of the 17 samples (median: 0.5 µg/g fur, range: 0.25–19.0 µg/g fur) (Fig. 1). Hen's egg protein was detected at a slightly higher concentration than peanut protein ($p = 0.04$). The levels of hen's egg and peanut protein were subsequently compared to those of Can f 1 in dog fur and Fel d 1 in cat fur. The median values of hen's egg, peanut, and Can f 1 levels in dog fur samples were 1.3, 0.35, and 0.6 µg/g fur, respectively. In cat fur samples, the median values of hen's egg, peanut, and Fel d 1 levels were 1.6, 0.8, and 3.0 µg/g fur, respectively. Thus, hen's egg and peanut protein are detected at comparable levels to those of Can f 1 or Fel d 1.

To date, this is the first study to show that hen's egg and peanut allergens were found in pet fur. The protein levels detected in pet fur were comparable to the levels of Can f 1 or Fel d 1, which are important aeroallergens for asthma and other allergic diseases.

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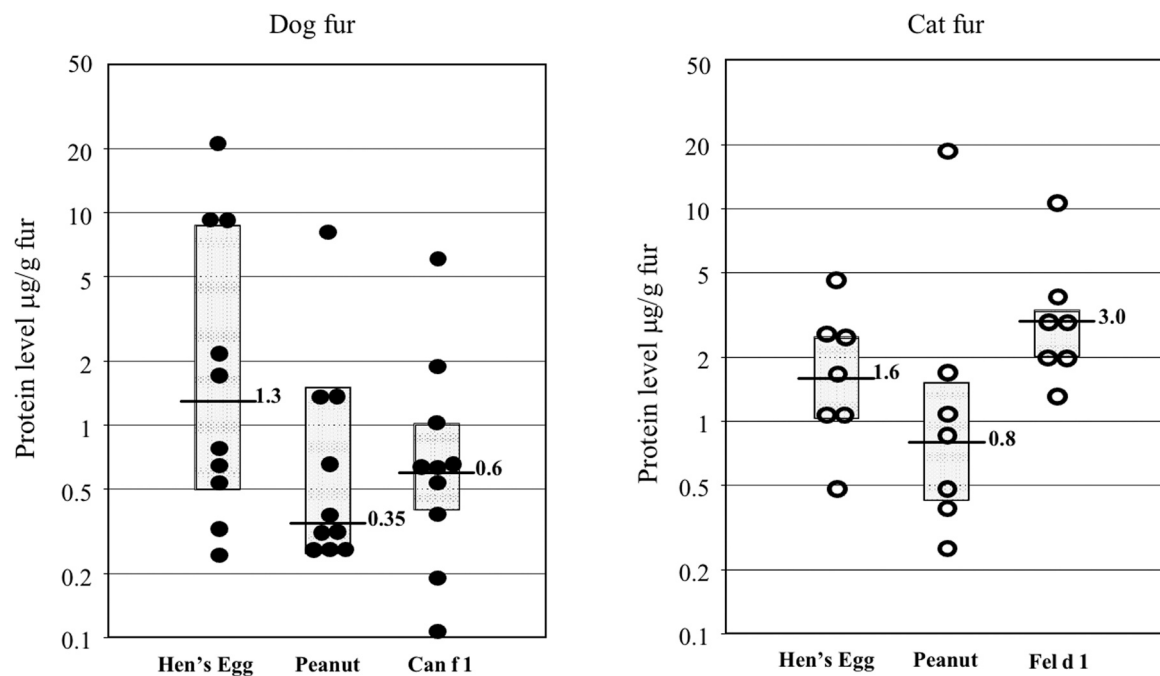


Fig. 1. Hen's egg and peanut proteins adhering to cat and dog fur The open and black circles represent the data of the cat and dog fur samples, respectively. The solid lines represent the median values of the hen's egg, peanut, and Can f 1 in dog fur or Fel d 1 in the cat fur. The box represents the central 50% range of the values.

Interestingly, hen's egg or peanut proteins were detected in the fur of some pets at comparable levels to those reportedly found in household dust [3–6].

The findings suggest that multiple origins, including those existing through the adherence of allergens to pet fur, should be considered in environmental food protein sensitization. This is particularly important to reduce environmental exposure to potentially allergenic foods as a preventable method of environmental food protein sensitization because the association between reduced environmental exposure to allergenic foods and reduced risk of sensitization and allergy has not been proven [3]. In addition, the findings also warrant further investigation on the association of the presence of food proteins on pet fur with allergic sensitization and/or the development of food allergies, as we speculate that indoor pets could be partially responsible for the spreading of food proteins, which adheres to the fur throughout the dwelling while moving about, or even involved in skin sensitization by the transfer of food proteins onto an infant's skin through grooming and licking behaviours from the fur.

This study has certain limitations. This is an observational pilot study to confirm the presence of hen's egg and peanut proteins on pet fur with a small sample size. Further research including a comparative study on the amount of food allergens between pet furs and house dusts in the same volunteer's dwelling is necessary to prove whether hen's egg or peanut allergens in pet fur could be responsible for food sensitization or even the development of food allergies.

In conclusion, hen's egg and peanut proteins were found in indoor dog and cat furs at concentrations comparable to those of dog or cat allergens, and even those of hen's egg and peanut protein reportedly found in household dust in some pets. These findings suggest that children could be exposed to food allergens in an unexpected way, warranting further investigation on potential allergen exposure routes and their association with allergen sensitization and/or the development of allergic diseases.

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Conflicts of Interest Statement

Masayuki Mikuriya and Fumitoshi Ogino are employees, of Duskin Co., Ltd.

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