Contaminants in duck and other speciality eggs

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Report Information Sheet

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Summary

The purpose of this study was to investigate the occurrence of a range of regulated and emerging organic environmental contaminants in duck and other non-hen eggs that are available for sale in the UK. Just over a hundred samples were analysed, and these included 70 duck and 10 quail eggs, but also eggs of other species such as goose, turkey, guinea fowl, ostrich, rhea, peafowl, pheasant, emu and gull. The EU regulatory limits for dioxins and PCBs in eggs apply only to hen eggs and egg products but the European Commission has suggested that it might be extended to other types of egg.

All egg samples were analysed for polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs, dioxins), polychlorinated biphenyls (PCBs), polybrominated diphenylethers (PBDEs) and polybrominated dibenzo-p-dioxins and dibenzofurans (PBDD/Fs, brominated dioxins). A sub-set of 20 samples were also analysed for emerging contaminants including polychlorinated naphthalenes (PCNs), and mixed halogenated dibenzo-p-dioxins, dibenzofurans and biphenyls (PXDD/Fs and PXBs).

The current scope of Commission Regulation 1881/2006 as amended by Regulation 1259/2011 on the dioxin and PCB content of food is limited to hen eggs and does not cover any of the eggs included in this study. Nevertheless, 19 samples, including 3 duck, 4 goose, 3 ostrich, 3 rhea, 2 gull and one each of emu, peafowl, turkey and pheasant, contained PCDD/F toxic equivalent (TEQ) levels that were above the regulated limit for hen eggs (2.5 pg/g fat). Twelve samples also were higher than the limit of 5.0 pg/g fat for the sum of dioxins plus dioxin-like PCB although, with the exception of the gull eggs, there was very little contribution from dioxin-like PCBs. The 2 gull eggs also contained indicator PCB levels that were above 400 ng/g fat (the limit for hen eggs is 40). Dioxins, PCBs, PCNs and PBDEs occurred in all egg samples, levels being lowest in quail eggs. PBDE levels ranged from 0.3 - 227 µg/kg fat (0.05 - 22.7 µg/kg whole) for the sum of the measured PBDE congeners with the highest levels by far, being observed in samples of gull eggs. The corresponding PBDE range for duck eggs was 0.4 - 12 µg/kg fat (0.07 -1.5 µg/kg whole).

Of the emerging contaminants, PCNs occurred in all of the measured samples (range1.6 – 20 ng/kg whole weight) with the highest levels occurring in duck, goose and gull eggs. In general, most PCN occurrence levels were higher than those reported in recent literature for hen eggs. The mean value for the TEQ arising from the measured PXDD/F and PXB congeners (0.25 ngTEQ/kg) was comparable to recently reported data (0.175 ng TEQ/kg) for eggs including hen, duck and gull. Most samples (>90%) showed the presence of brominated dioxins, with a greater frequency of PBDF occurrence as observed in other studies. The TEQ levels for PBDD/Fs were generally lower than the corresponding chlorinated dioxin TEQ, although a small proportion (10-15%) of samples showed comparable TEQ values.

This study highlights the ubiquity of these contaminants in duck and other non-hen eggs, and provides the first such broad dataset of its kind for these foods. The data allows the definition of a baseline level for the emerging contaminants and provides a basis for the estimation of risk to consumers of these foods.

1. Introduction

Environmental contaminants such as dioxins, PCBs and brominated flame retardants (PBDEs and HBCD) are known to occur in chicken eggs, but there is little knowledge about the extent of their occurrence in the eggs of other species that are used for food. As part of earlier studies on individual foods, limited data on duck tissue and eggs has shown that these may contain higher levels of contamination than commercial hen eggs. Reports of investigations carried out in other countries, especially around waste sites (Qin et al, 2011, Labunska et al, 2014), suggest that duck eggs are susceptible to contamination from localized pollution hotspots. Similarly gull eggs have been shown to contain several times the contamination level of dioxins and PCBs in hen eggs (Fernandes et al, 2006). There is little or no information on dioxin, PCB or PBDE levels in the eggs of other species (non-hen) that are sold commercially or produced for consumption, and there is no data for other contaminants such as brominated dioxins and mixed halogenated dioxins and biphenyls. This project aims to provide data for dioxins, PCBs, PBDEs and brominated dioxins (PBDD/Fs) in retail duck and other non-hen species, eggs, and to carry out an initial investigation on the occurrence of other contaminants in a sub-set of these samples.

2. Samples and Methods

Just over a hundred egg samples were collected from different locations across the UK with outlets including supermarkets, farm shops and specialist food stores. The majority of these were duck eggs (n=70), but they also included eggs of other species as shown in the table below.

Species	No. of egg samples
Duck	70
Quail	10
Goose	6
Ostrich	3
Turkey	3
Rhea	3
Guinea fowl	2
Pheasant	2
Peafowl	2
Gull	2
Emu	1

Analysis for all contaminants (PCDD/Fs, PCBs, PBDEs, PBDD/Fs, PCNs and PXDD/Fs and PXBs) was carried out as in previous studies for the FSA, using internal standardization with ^{13}C labelled material. Analytes were measured by GC-high resolution mass spectrometry (up to 13.5 K resolution for the PXDD/Fs and PXBs), apart from the ortho substituted PCBs which were measured by GC-unit resolution mass spectrometry.

The PBDEs measured were the 17 congeners that have been quantified in previous work for the FSA. (BDE-17, **BDE-28, BDE-47, BDE-49**, BDE-66, BDE-71, BDE-77, BDE-85, **BDE-99, BDE-100,** BDE-119, BDE-126, **BDE-138, BDE-153, BDE-154, BDE-183 and BDE-209**). These include the 10 PBDE congeners (highlighted in bold) that have been specified in EU Commission Recommendation 2014/118.

All of the methodologies that were used have been published in peer reviewed journals (Fernandes et al, 2004, 2008, 2010, 2011). These methods have been used to carry out investigations or surveys on food and animal feed for the FSA and other regulators. The methodologies are continuously validated by regular and successful participation in international proficiency testing (Dioxins in food, 2014, 2015, Malisch et al, 2015) where available (PCDD/Fs, PXBs and PBDEs). The results of In House Reference Material (IHRM) analyses have been included with the results (PCDD/F, PCBs PBDEs, PCNS, PXDD/Fs and PXBs).

3. Results

The results are presented as an excel spreadsheet in Annex 1.

The results are reported in conventional units – ng/kg or µg/kg on a fat weight basis, and where required (e.g. PBDEs, PCB and PCDD/F TEQ), on a whole weight basis as well. The limits of detection (LODs) were calculated dynamically during analysis and incorporated the associated procedure blanks that were routinely used. The LODs are generally better than those proposed or quoted in Commission Regulations/Recommendations for regulated contaminants, or in the open literature for the emerging contaminants.

Dioxins and PCBs occurred in all egg samples, but levels were lowest in quail eggs.Combined PCDD/F and PCB occurrence ranged from 0.16 pg TEQ/g fat to 22.9 pg TEQ/g fat. In the vast majority of cases (apart, notably from gull eggs) PCDD/Fs contributed to a much greater extent

(average 72%) to TEQ occurrence than PCBs. The current scope of EU regulation on PCDD/F and PCB content of food does not cover any of the samples included in this study, but 19 samples, including 3 duck, 4 goose, 3 ostrich, 3 rhea, 2 gull and one each of emu, peafowl, turkey and pheasant, showed toxic equivalent (TEQ) levels that were above the regulated PCDD/F limit for hen eggs (2.5 pg/g fat). Of these, 12 samples also showed concentrations of combined PCDD/F and PCB TEQ that were above the regulated limit (5pg/g fat) for hen eggs. Additionally, the two gull egg samples showed indicator PCB levels that were greater than 400 ng/g fat (regulated limit for hen eggs - 40 ng/g fat). In comparison to duck, quail and guinea fowl, eggs of the other measured species tended to show relatively higher levels of these contaminants.

PBDE levels ranged from 0.3 - 227 µg/kg fat (0.05 -22.7 µg/kg whole) for the sum of the measured PBDE congeners with the highest levels by far being observed in samples of gull eggs. The corresponding PBDE range for duck eggs was 0.4 - 12 µg/kg fat (0.07 -1.5 µg/kg whole). BDE-209 was generally the predominantly occurring PBDE congener across all species.

Of the emerging contaminants, PCNs occurred in all of the measured samples (range1.6 – 20 ng/kg whole weight) with the highest levels occurring in duck, goose and gull eggs, which are the birds most likely to be exposed in the aquatic environment. In general, most PCN occurrence levels were higher than those reported in recent literature for hen eggs (Fernandes et al, 2010, 2011). The mean upper bound value for the TEQ arising from the measured PXDD/F and PXB congeners (0.25 ng TEQ/kg) was comparable to recently reported data (0.175 ng TEQ/kg) for eggs including hen, duck and gull (Fernandes et al, 2014). Most samples (>90%) showed the presence of brominated dioxins with a greater frequency of PBDF occurrence, as observed in other studies. The upper bound TEQ levels for PBDD/Fs were generally lower than the corresponding chlorinated dioxin TEQ, but a small proportion (10-15%) of samples showed comparable TEQ values.

This study highlights the ubiquity of these environmental contaminants in duck and other non-hen eggs, and in some cases provides the first data of its kind for these foods. The data allows the definition of a baseline level for these contaminants and provides a basis for an estimation of risk to consumers of these foods.

4. Conclusions

The sample types included in this study are currently unregulated for established contaminants such as dioxins and PCBs, but the data presented here underline their universal occurrence in duck and other non-hen eggs, at concentrations that are sometimes higher than those reported for hen eggs.

The study provides the first data of its kind on these contaminants, thus providing a baseline from which future studies can be assessed.

The relatively elevated levels of some contaminants particularly PCDD/Fs and PCBs will contribute to the discussion on these foods at an EU level, and suggest that future monitoring would be prudent, especially before extending the regulatory limits from hen eggs to eggs of other species.

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