# FOLLOW-UP ASSESSMENT OF PCDD/PCDF IN EGGS FROM ALLOTMENTS IN NEWCASTLE UPON TYNE, ENGLAND

Vivienne Air[1], Tanja Pless-Mulloli[2], Bernd Schilling[3], Olaf Paepke[3], Kirsty Foster[2]

[1] Public Health and Environmental Protection Department, Newcastle City Council, Newcastle upon Tyne England
[2] Department of Epidemiology and Public Health, Newcastle University, Newcastle upon Tyne England
[3] Ergo Research Laboratory, Hamburg, Germany

## Introduction

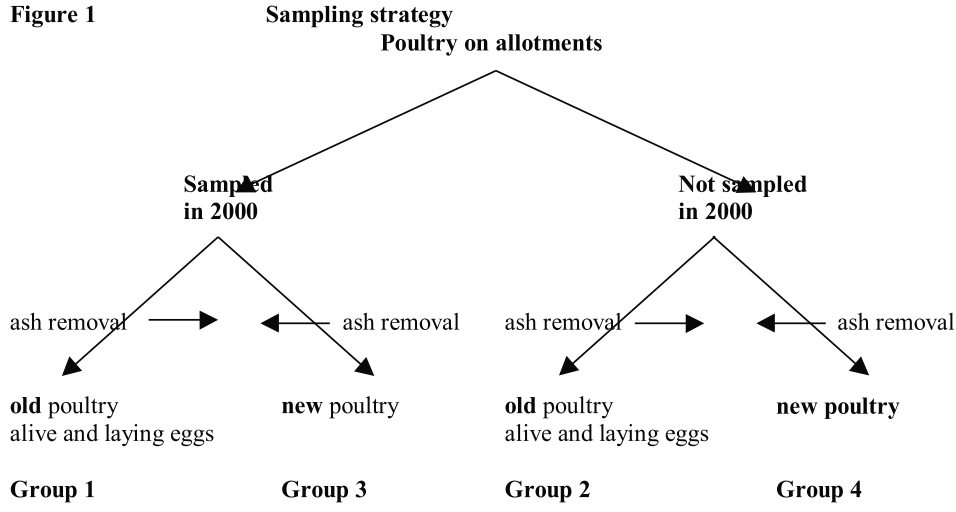
In 2001 we reported a study of polychlorinated dibenzo-p-dioxins (PCDD) and dibenzofurans (PCDF) in eggs from poultry reared on allotments in Newcastle upon Tyne. This followed the discovery that incinerator ash (in this case a mixture of slag, bottom ash and fly ash) had been used on footpaths and in some cases within poultry pens at the allotments. Results showed PCDD/F levels well in excess of levels from barn held supermarket eggs. The congener pattern in eggs was similar to that in ash indicating a link between the use of the incinerator ash, with 17 out of 19 egg samples showing the congener pattern of ash.[1,2]. This follow-up investigation 20 months after the removal of ash sought to a) establish whether levels of contamination in eggs from original poultry have declined and b) ascertain that the levels of contamination in eggs from new poultry are within the expected levels for free range eggs.

## Methods

A questionnaire survey was conducted of 86 poultry holders at 12 allotment sites where it was known that the incinerator ash had been used, to identify those individuals willing to provide egg samples. The survey also collected data on whether the birds held were original stock from the time when ash had been present at the site, or were new stock introduced since ash removal. 64 questionnaires were returned confirming laying poultry at 11 of the sites.

Based on the results of the survey, a sampling and analytical strategy was devised. Four groups of eggs were available: (see figure 1):

**Group 1:** eggs from poultry previously sampled in 2001, where old poultry had been retained and were still laying (n=5); **Group 2:** eggs from poultry not previously sampled but where the original poultry (n=10) was retained and was laying; **Group 3:** eggs from newly introduced poultry from owners whose poultry was previously sampled (n=12); **Group 4**: eggs from newly introduced poultry from owners whose poultry was not sampled in 2001 (n=20). The analytical strategy was that, where previous data were available from the 2001 study which used HR-GCMS analysis (Groups 1 and 3), individual samples from each poultry holder (composite of 2 to 4 eggs), were again analysed using HR-GCMS (ERGO Laboratories Hamburg, Germany). Where previous data were not available (groups 2 and 4), samples were pooled within type of poultry and across similar distance from the original ash, from a maximum of two poultry holders at each allotment site. Where the number of individuals on a site willing to donate eggs exceeded two, then multiple samples from one site resulted. For these samples, the CALUX® assay based upon the biological response to dioxin like compounds




(Biodetection Systems BV (BDS) Laboratories Amsterdam, Netherlands) was used. The results of the CALUX® tests are reported separately. Here we present the data from groups 1 and 3 only.

Forty-eight samples were collected from eleven allotments. One sample of six eggs was collected from a city farm where no incinerator ash had been used, to act as a control. Eggs were individually labelled. A record sheet was filled in recording: name of allotment, allotment plot number, allotment owner at time of sampling, duration which the allotment has been in use by current owner, type of produce sampled, age of poultry and length of time on the allotment, distance from any ash path, whether ash was used on plot and details of feed used, date of collection. Samples for HR-GCMS analysis were homogenised, and transported to Ergo at -20 °C.

**Data Analysis and Interpretation**

A total of 19 samples were analysed using HR-GCMS (Group 1: n=6, Group 3: n=12, G, control: n=1). For Group 1 the PCDD/F concentration in ng/kg I-TEQ per gram lipid were individually compared with previously recorded levels. The contribution of incinerator ash and other PCDD/F sources to the congener pattern in Groups 1 and 3 samples were examined. Both the incinerator ash and eggs had shown a characteristic zigzag shaped congener pattern characteristically with TCCD<PCDD<HxCDD<HpCDD,OCDD and HxCDF>HpCDF>OCDF. We used descriptive statistical analysis to summarise the data and compared levels with those reported in the literature and EU target values.[3]

**Results and Discussion**

Table 1 shows a summary of the I-TEQ concentrations in ng/kg I-TEQ (lipid base), compared to the levels found in the previous 2001 study and the congener pattern.

The weighted average for Group 1 eggs was 12.9ng/kg I-TEQ (n=19; min 2.1, max 26ng/kg I-TEQ). Three samples included eggs from identical birds and were now lower than in 2001 (sites 3,7,8), two samples were higher (sites 1, 6) and one sample had a similar level (site 10).

The weighted average for Group 3 eggs was 7.9ng/kg I-TEQ (n=34; min 0.2ng/kg I-TEQ, max 31ng/kg I-TEQ). Levels in six of the samples in Group 3 were much lower than eggs from birds

**Table 1.** PCDD/F concentration in egg samples in ng/kg I-TEQ

| Site No | PCDD/F ng/kg I-TEQ 2002 | H=Hen B=Bantam (No. of eggs in sample) | | 2002 Pattern: I= Newcastle incinerator, O=Other | PCDD/F ng/kg I-TEQ 2001 | 2001 Pattern |
|---|---|---|---|---|---|---|
| **Group 1: eggs from poultry previously sampled, poultry retained and laying** | | | | | | |
| 1 | 2.1 | H | (4) | I,O | 0.8 | I,O |
| 3 | 18 | H | (3) | I | 25 | I |
| 6 | 6.6 | H | (3) | I,O | 1.5 | O |
| 7 | 11 | H | (3) | I | 25 | I |
| 8 | 17 | H | (3) | I | 29 | I |
| 10* | 26 | H | (3) | I | 27 | I |
| **Group 3: eggs from new poultry, where eggs were previously sampled** | | | | | | |
| 1 | 13 | H | (3) | I | 8.9 | I,O |
| 3 | 21 | B | (2) | I | 56 | I |
| 4 | 31 | B | (2) | O | 17.5 hen | I |
| 5 | 5.4 | H | (3) | I | 7 | I |
| 7 | 1.7 | H | (3) | I | 25 | I |
| 7 | 6.7 | H | (3) | I | 25 | I |
| 8 | 5.1 | H | (2) | I,O | 29 | I |
| 8 | 5.2 | B | (3) | I,O | 3.6 | I |
| 8 | 0.2 | H | (3) | O | 0.4 | I |
| 10 | 7.8 | H | (3) | I | 27 | I |
| 10 | 6.7 | H | (3) | I | 27 | I |
| 11 | 3.3 | H | (4) | O | 5.6 | I |
| **Control** | | | | | | |
| n/a | 3.4 | H | (2) | I,O | n/a | n/a |

* This sample may possibly include Group 3 eggs(s)

previously kept on that allotment reported in the 2001 study (sites 3, 7, 8, 10), two were higher (sites 1, 8), two were similar (sites 5, 11) and for one comparison was not possible as the type of poultry had changed from hen to bantam (site 4). The minimum level was 0.2ng/kg I-TEQ for hen eggs and 5.2ng/kg I-TEQ for bantam, the maximum levels were 13ng/kg I-TEQ for hen and 31ng/kg I-TEQ for bantam eggs.

Table 2 shows a summary of the results. On average, levels of PCDD/F had declined considerably from those 20 months ago from 16.4ng/kg I-TEQ to 9.4ng/kg I-TEQ following removal of the source of exposure. Eggs from newly introduced hens (Group 3) showed a weighted mean level of 5.5ng/kg, considerably lower than Group 1 eggs (mean including bantam eggs 7.9ng/kg I-TEQ). However levels in both Groups 1 and 3 eggs were above the forthcoming EU target level of 3ng/kg lipid. A range of levels similar to those found in Group 3 hens in this study was recently reported from an investigation of the UK Food Standards Agency[5]. There were two surprising findings: The majority of new poultry introduced after ash removal produced eggs with considerable levels of contamination. Secondly, the Newcastle incinerator congener pattern was still dominant in many Group 3 egg samples, both in samples with low and high overall levels.

One possible explanation for this finding is that ash removal had been incomplete leading to further intake after the removal of the bulk of the ash. We also considered the possibility that sources other than the Newcastle incinerator may have resulted in the congener pattern found in newly introduced eggs. Two further considerations relate to either differential uptake or differential excretion of congener groups as reported by Stephens et al[6] or a combination of the two. While we cannot fully rule out the alternative explanations we currently still judge it most likely that the exposure source is a Newcastle specific source related to the incinerator.

**Table 2.** Summary of PCDD/F results in eggs

| Samples | **No of eggs** | **Weighted average [I-TEQ in ng/kg lipid base)** |
|---|---|---|
| All 2002 | 55 | 9.4 |
| Group 1 eggs (hen) | 19 | 12.9 |
| Group 3 eggs (hen and bantam) | 34 | 7.9 |
| Group 3 eggs (hen only) | 30 | 5.5 |
| 2001 study | | |
| (all: hen, bantam and duck | 38 | 16.4 |
| 2001 study (hens only | 33 | 14.8 |

**Conclusions**

The decline in the PCDD/F concentration in Group 1 eggs after removal of the exposure source incinerator ash was less than had been expected on the basis of first principle considerations of how much lipid hens would excrete by laying eggs over the 20 months period between the initial and the second sampling. Furthermore, many samples both in Groups 1 and 3 still showed the congener pattern, which had characterised the incinerator ash. Most levels found in the free-range eggs would breach the forthcoming EU standards for eggs.

**References**

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