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Investigations on the transfer of non-dioxin like PCBs from feed into eggs of laying hens

Dr Robert Pieper
German Federal Institute for Risk Assessment, Max-Dohrn-Str 8-10, 10589 Berlin, Germany

Summary

Polychlorinated biphenyls (PCBs) are a group of 209 congeners of chlorinated substances that differ in the number (1-10 per molecule) and position of the chlorine atoms on the biphenyl. Unlike dioxins, PCBs were intentionally manufactured and have been used in the past for various applications, mainly as non-burning and viscous fluids with low conductivity in transformers and hydraulic oils. Despite their worldwide ban, PCBs still occur as undesirable by-products of chemical reactions.Like dioxins, PCBs are lipophilic, chemically and thermally stable (persistent) and accumulate in the tissues of humans and animals alike. A toxicological classification for ndl-PCBs is currently difficult due to few available studies.

In autumn 2018, non-dioxin-like polychlorinated biphenyls (ndl-PCBs) were detected in samples of feed and food of animal origin in three federal states at concentrations above the legal maximum levels. The cause of the contamination in 2018 was apparently paint chipping in loading cells of a feed manufacturer. Subsequently, the excessive levels in the feed led to exceedances in foodstuffs (poultry meat, eggs) obtained from the fed animals. Currently, only few data are available on the transfer behaviour of individual ndl-PCB congeners from the feed to the farm animal and the food derived from it. Therefore it seems sensible and even necessary to carry out targeted transfer studies with defined ndl-PCB concentrations and known congener patterns in animal feed in order to better estimate their transfer into eggs and possible metabolism.
Based on this experiment, toxicokinetic model for the excretion behaviour of ndl-PCB congeners is developed at BfR. Such models serve as the basis for computer programs that are to serve feed and food monitoring as management tools in the event of an incident.

Registration details	
Status of the study	Accessible
Date of registration	2021-04-20
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1. General Information

Keywords

laying hens, eggs, toxicokinetic modeling, gallus gallus domesticus, indicator PCBs, PCB metabolism

Funding sources

Institutional funding

International code of classification

Not provided

2. Study design

Introduction

In autumn 2018, ndl-PCBs were detected in individual samples of poultry meat and eggs in Germany at concentrations exceeding the maximum level for these products4. The putative cause was identified as (PCB-containing) paint in the loading cells of a feed company. In the course of the incident, we obtained feedstuff for fattening poultry that only slightly exceeded the maximum permitted levels for compound feed for chickens, but apparently caused a significant exceedance of ndl-PCB maximum levels in chicken meat. As a follow-up on this event, a feeding study was conducted with laying hens receiving a diet with a known ndl-PCB content. The results were evaluated with a toxicokinetic model to evaluate 1) to what extend can compound feed for chicken compliant with ndl-PCB maximum levels lead to food that is not compliant with maximum levels in food, and 2) evaluate the ndl-PCB congener profiles between feed and food and possible chlorination-dependent differences in the bioaccumulative properties

Type of research

Exploratory

Hypothesis of your study

The non-dioxin like polychlorinated biphenyls are quantitatively being transferred into the eggs of chicken (data collection to design a toxicokinetic model)

Study design

A feeding study with laying hens was carried out to generate a toxicokinetic model based on the data. For this purpose, feed contaminated with ndl-PCB (KFM, requirement approx. 120 g/day/animal, total requirement approx. 300 kg) or uncontaminated feed (UFM, with background contamination) was fed. The control group in the laying hen study represents all animals before the start of the main trial period (as they are initially fed UFM, which is then switched to KFM); in the chicken fattening trial, there will be a control group fed only UFM; all other groups will be fed the KFM for varying periods of time.A total of n=30 laying hens will be studied in this trial. All animals (pullets, housed at approx. 16 weeks of age) initially received UFM at the beginning of the laying phase, which was switched to KFM at approx. 20 weeks of age (trial day 1). After feeding KFM for 4 weeks (trial days 1 to 28), a washout period followed for half of the birds (group A), during which they received UFM. The remaining 15 laying hens (group B) received KFM for another 5 weeks (days 28 to 63). After that, all birds (group A and B) continued to receive UFM (approx. 160th day of the trial) during which eggs were collected at regular intervals. The eggs were pooled per day and analysed for ndl-PCB on selected days.

Method of blinding

Primary data analysis is conducted in a blinded manner

Method of randomization

Chickens were randomly allocated into the different groups.

3. Methods

3.1. Analysis of non-dioxin like polychlorinated biphenyls (ndl-PCBs) in eggs were performed by gas chromatography (GC) and h

Description of the method

The quantitative determination of the ndl-PCBs in the samples is carried out in the NRL for halogenated persistent organic pollutants (NRL POP). Homogenisation of the samples is followed by dehydration, extraction and clean up. The analysis is performed by coupling gas chromatography with high resolution mass spectrometry (GC-HRMS)

Narcotic/analgesic treatment

Not applicable

Drugs/substances

Not applicable

Antibodies

Not applicable

Cell lines, viruses, DNA or RNA constructs and bacteria

Not applicable

4. Statistics

4.1. Toxikokinetic Modelling

Assigned method(s)

Analysis of non-dioxin like polychlorinated biphenyls (ndl-PCBs) in eggs were performed by gas chromatography (GC) and h

Main endpoints

Concentration of ndl-PCB in hen eggs

Secondary endpoints

Not specified

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Sample size calculation

Sample size was set based on necessary amount of data to derive appropriate toxikokinetic models für ndl-PCB congeners. However, no a priori sample size calculation was performed.

Primary statistical analysis

Toxikokinetic Modelling

Exclusion criteria

Not specified

5. Animals

5.1. Domestic fowl (Gallus gallus domesticus)

Animal strain/breed

Leghorn

Genetically modified

No

Sex

Female

Further characteristics of the animals (e.g. age, body weight, size)

Juvenile hens at the age of approx. 16 weeks

Housing conditions

Laying hens were kept in two groups of 15 animals each under floor housing conditions. The animals were kept in pens (1.5m x 2.75m) with concrete floor and sawdust bedding. Water and assigned feed were provided ad libitum. Health status including behavior, feed and water intake, appearance and fecal consistency was checked daily. Housing, animal care and animal medical care comply with requirements according to Directive 2010/63/EU on the protection of animals used for scientific purposes (EU, 2010).
Directive 2010/63/EU of the European parliament and of the of 22 September 2010
on the protection of animals used for scientific purposes. Official Journal of the European Union L276:33-79

Refinement

Not specified