

INFLUENCE OF DIOXIN CONTAMINATED FEED AND ITS EFFECT UPON THE CONTENT IN ADIPOSE TISSUE OF PIGS

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Abstract

Pigs exposed to a mixture of PCDD/F and PCB, administered via capsules, were investigated on their accumulation and elimination of these compounds. During early periods of fattening the dioxin levels marginally above the allowed limits in contaminated feed will not lead to categorically elevated dioxin content at the moment of slaughtering. The TEQ was also reduced intensely at the three groups of different exposure during the 10 week lasting period with uncontaminated feed. However for the two high dosage groups of 10 and 100 ng TEQ/kg feed-TS it was not possible to reduce the concentrations below the allowed limit of 1 pg WHO-PCDD/F-TEQ/g for pork. Furthermore, this study points out the necessity to consider the composition of congeners in contaminated feed because the decrease of tetrachlorinated and pentachlorinated congeners were more pronounced than the decrease of octachlorinated congeners.

Introduction

90% of the dioxin exposure found in humans is a result of contaminated food. Foods of animal origin are the major source of exposure. The major cause of dioxin content in our food is the contamination of animal feed¹.

In recent years several cases of contaminated feed were experienced, which had been caused by different reasons, namely:

- Use of ball clay from different locations as flow supporting agent. Ball clay is believed to be contaminated with a specific pattern caused by geothermal processes
- Drying of grass by use of wood contaminated with preservatives
- Contamination of feed by wood treated with preservatives
- Contamination of feed with waste originating from technical industry (PCB-oils etc.)

For the animal species pig there are only a few studies about defined exposure to PCDD/F in relation to their concentrations in different tissues^{2,3}. The purpose of this study was to examine the development of dioxin in adipose tissue of pigs fed with three different dosages in their feed by employing contaminated capsules as PCDD/F-vector.

Materials and Methods

During the first period pigs received dioxin contaminated feed. The second period of feed was nearly free of dioxin. The experiment extended over 23 weeks. Four groups containing 8 weaned pigs with an average weight of 8.8±1.0 kg each were arranged.

Three of those groups obtained a PCDD/F-PCB-mixture (Table 1) in capsules with a total concentration of 1, 10 and 100 ng TEQ/kg feed-TS, respectively, for a period of 11 weeks, whereas one group formed the control group and received uncontaminated feed. The capsule technique was chosen because it made sure that the dose of PCDD/F was completely ingested at a high degree of reliability, since the animals might have refrained from uptake of the complete feed contaminated by other means. In the following period of 10 weeks all four groups were nourished with uncontaminated feed. At the end of the exposure period, in the middle and at the end of the

period of dioxin-free feed subcutaneous fat biopsies under anaesthesia were performed. They were analysed with high resolution gas chromatography (HRGC) in combination with high resolution mass spectrometry (HRMS) regarding their dioxin content.

Table 1: PCDD/F and PCB administered to pigs in the experimental setup.

<i>Substance</i>	<i>WHO-TEF</i>
PCB 126	0.1
2,3,7,8-TCDD	1
1,2,3,7,8-PeCDD	1
1,2,3,4,7,8-HxCDD	0.1
1,2,3,4,6,7,8-HpCDD	0.01
OCDD	0.0001
2,3,7,8-TCDF	0.1
2,3,4,7,8-PeCDF	0.5
OCDF	0.001

Results and Discussion

The PCDD/F-TEQ at the first sampling were 0.02, 3.23, 37.1 and 193 pg WHO PCDD/F-TEQ/g fat for the control group, the group D1, D10 and D100, respectively (Table 2). The content of dioxin in adipose tissue decreased by 20% in all three groups during the 10 week lasting feed period with uncontaminated feed. Partly this decrease derives from the increase of adipose tissue of growing pigs, which reflects the dilution by growth. Fries et al. concluded from this increase of bodyweight the major reason for the decreased concentration of PCDD/F⁴. Nevertheless, it is important to emphasise that the amount of adipose tissue tripled whereas the concentration of dioxin diminished by a factor of 5 to a factor of 7. That does not only mean that the relative content of dioxin concentration in adipose tissue was reduced but the results show that the absolute content of dioxin concentration also decreased.

Contaminated adipose tissue caused by administering dioxin contaminated capsules and accompanied with normal feed ingestion with a minimum above the allowed limit (1 ng WHO-TEQ/kg TS) was incurred after a 10 week period with uncontaminated feed within the allowed compulsory limits of 1 pg WHO-PCDD/F-TEQ/g for pork.

The concentration of dioxins decreased in all three groups at an average of 82.5%. The reduction of the concentrations in the first period of dioxin-free feeding was about 66% and significantly higher than in the second period (49%). A similar decrease was observed by Thorpe et al. in cattle⁵.

This leads to a conclusion that during early periods of fattening the factor of dioxin marginally above the allowed limits in contaminated feed will not lead to categorically elevated dioxin content at the moment of slaughtering. The TEQ was also reduced intensely at group D10 and D100 during the 10 week lasting period with uncontaminated feed.

Nevertheless, it was not possible to reduce them below the allowed limit of 1 pg WHO-PCDD/F-TEQ/g fat. Furthermore, this study points out the necessity to consider the composition of congeners in contaminated feed because the decrease of tetrachlorinated and pentachlorinated congeners were stronger than the decrease of octachlorinated congeners, because in this work as well as in other studies a more rapid decrease of TCDD (96.0%) and TCDF (95.6%) was determined in contrast to OCDD (66.1%)^{2,6}.

Table 2: Mean PCDD/F- concentrations in fat tissue of pigs after week 13, 18 and 23 in pg WHO-TEQ/g fat

	Week 13 (57 kg BW)	Week 18 (89 kg BW)	Week 23 (115 kg BW)
Controlgroup	0.02 ± 0.04 ^a	0.07 ± 0.12 ^a	0.06 ± 0.1 ^a
Group 1: 1 ng TEQ/kg TS	3.23 ± 1.06 ^{ac}	1.30 ± 0.47 ^{ac #}	0.66 ± 0.21 ^{ac #}
Group 2: 10 ng TEQ/kg TS	37.1 ± 6.3 ^{bc}	12.6 ± 2.5 ^{bc}	6.49 ± 1.26 ^{bc #}
Group 3: 100 ng TEQ/kg TS	193 ± 44 ^b	54.2 ± 9.34 ^{b #}	27.1 ± 4.2 ^{b #}

^(a,b,c) different letters mark significant differences between the groups at the same time

[#] (p<0,05) significant difference within a group in comparison to week 13 BW = body weight

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