PCDD/PCDF IN COMMERCIAL CHICKEN EGGS- DEPENDENCE ON THE TYPE OF HOUSING

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Introduction

Previous studies have shown that foraging chickens can take up polychlorinated dibenzodioxins (PCDD) and dibenzofurans (PCDF) from soil and rapidly transfer them into eggs[1-3]. Moreover, these studies indicated that the concentrations and congener profiles of PCDDs and PCDFs in eggs of chickens appear to be related to the soil on which they are raised. Consequently, PCDD/PCDF levels up to 300 ng I-TEq (NATO/CCMS)/kg fat were reported for eggs from chickens which were kept on contaminated areas in the vicinity of hot spots[3]. The bioaccumulation of PCDDs/PCDFs in chicken eggs is of special interest because they play an important role in human nutrition. Whereas the above mentioned studies were mainly performed with samples collected at hot spots, data on PCDD/PCDF levels in commercial chicken eggs are scarce. However, these data are necessary in order to calculate the average daily PCDD/PCDF intake from eggs for the normal population as a basis for a meaningful risk assessment.

Approach And Methods

51 samples each comprising 6-10 eggs were randomly collected in grocery stores, on markets and directly at the producers within the framework of official German food control. Special emphasis was put on the type of chicken housing. For this, eggs were not only collected from laying hens housed in elevated wire cages but also from hens kept on ground and from foraging chickens. All analyses were performed with well-proven analytical methods including congener-specific determination by use of high resolution gas chromatography/high resolution mass spectrometry at a resolution power of R = 10000. The laboratory succeeded in various national and international quality control studies.

Results And Conclusions

The result of this investigation is shown in Figure 1. For better comparison all data are given as ng I-TEq (NATO/CCMS)/kg fat. The histogram clearly demonstrates that the majority of PCDD/PCDF levels in eggs from chickens housed in elevated wire cages is in the range between 0,5 and 2,0 ng I-TEq (NATO/CCMS)/kg fat. In contrast, eggs from chickens kept on ground and from foraging chickens raised on fields show a broader range of contamination. In both cases a considerable number of samples revealed PCDD/PCDF levels above 2 ng I-TEq (NATO/CCMS)/kg fat. The highest level was found to be 23,4 ng I-TEq (NATO/CCMS)/kg fat.

Figure 2 shows some typical PCDD/PCDF profiles in eggs from foraging and caged chickens. For this graph each homologue group is presented as percentage of the total sum of PCDDs/PCDFs. The first two samples (foraging 1 + 2) originate from hens raised on fields which were partly contaminated by emissions from a severe fire involving burning of several hundred tons of PVC. As expected, the PCDD/PCDF profiles in eggs are dominated by lower chlorinated dibenzofurans and resemble the profiles found in the corresponding soil and vegetation. In the second sample this profile is overlayed by a characteristic pentachlorophenol (PCP) related congener profile. The sample collected from caged chickens reveals the typical situation for eggs from laying hens housed in elevated wire cages with no access to contaminated soil and fed a commercial diet. In contrast to other types of foodstuffs analysed so far, in almost all cases OCDD was the predominant congener with a share of up to 50% of total PCDDs/PCDFs.

In summary, commercial chicken eggs may contain significant amounts of PCDDs/PCDFs dependent on the type of housing. Taking the worst case with the highest level of 23,4 ng I-TEq (NATO/CCMS)/kg fat into account and assuming a daily consumption of only one of these eggs, this would result in an intake of approximately 140 pg I-TEq (NATO/CCMS)/day or 2 pg (NATO/CCMS)/kg body weight/day. This amount almost doubles the average daily intake from other food sources.

References

[1] Chang R, Hayward D, Goldman L, Harnly M, Flattery, J, Stephens R. Foraging farm animals as biomonitors for dioxin contamination. *Chemosphere* 1989;19:481-6.

[2] Stephens RD, Harnly M, Hayward DG, Chang RR, Flattery J, Petreas MX, Goldman L. Bioaccumulation of dioxins in food animals II:Controlled exposure studies. *Chemosphere* 1990;20:1091-6.

[3] Wuthe J. In: *Current views on the impact of dioxins and furans on human health and the environment*, Berlin Nov.9-11 1992. The Toxicology Forum 1993:252-63.

Figure 1

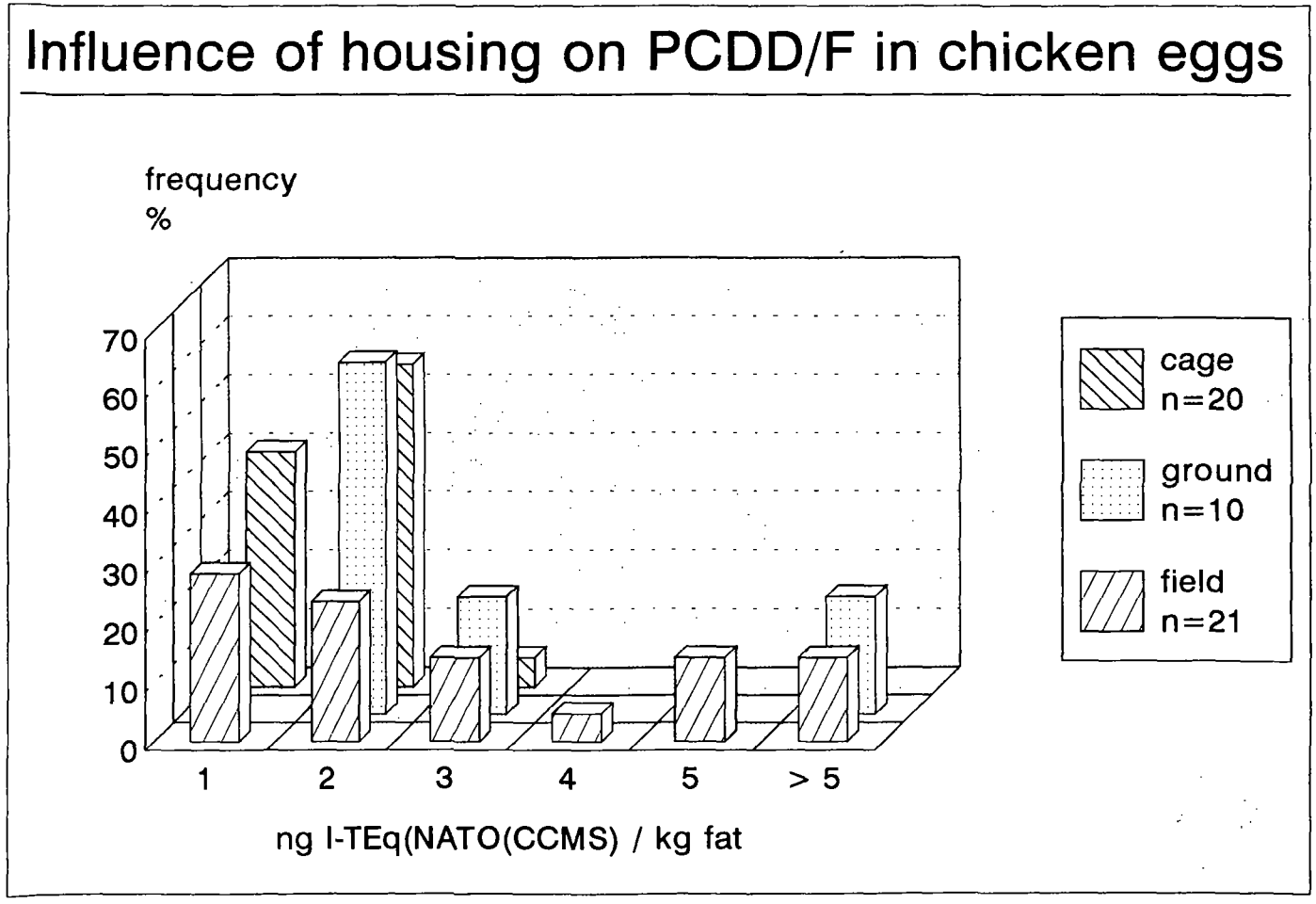
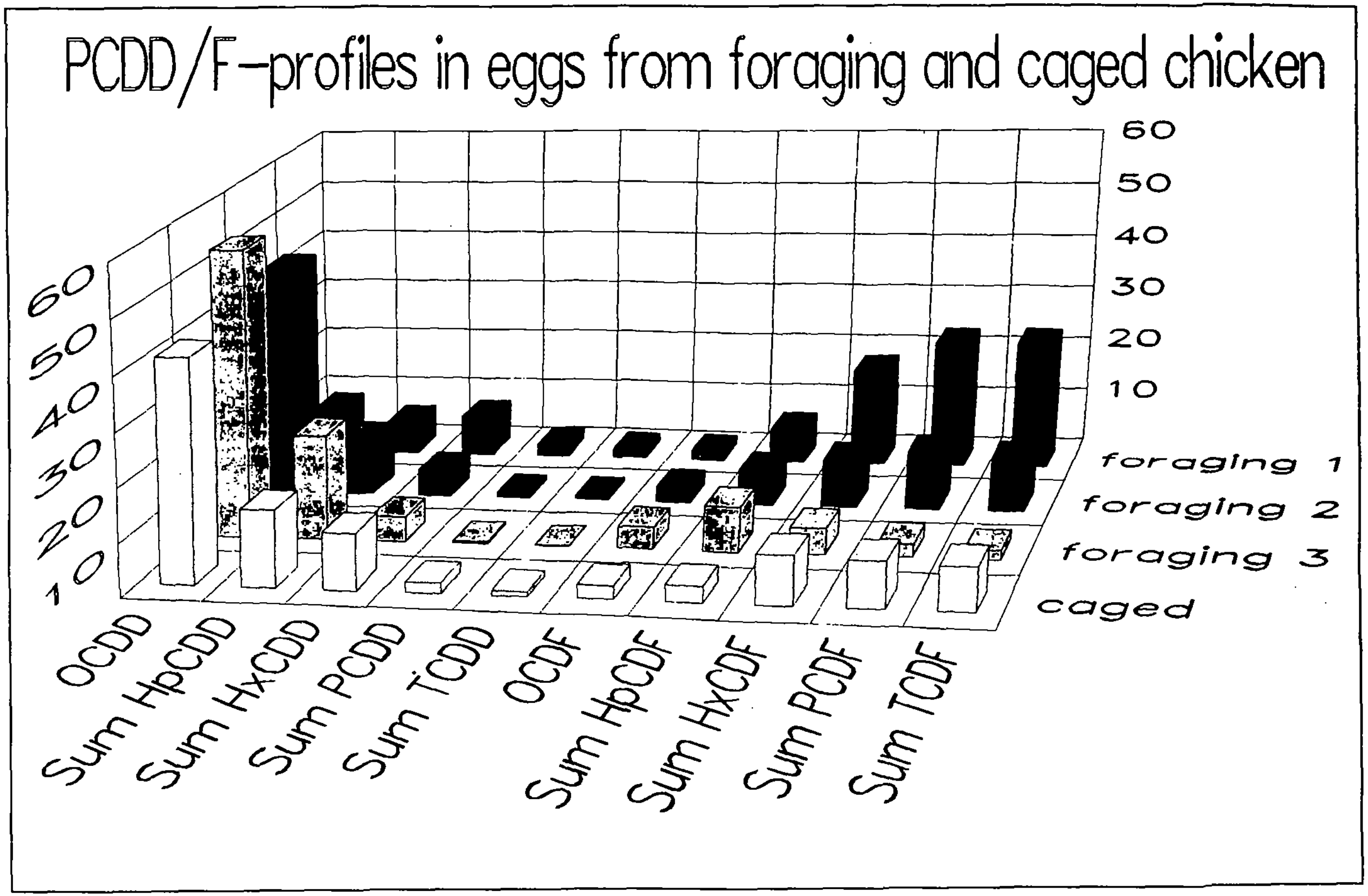

Influence of housing on PCDD/F in chicken eggs
frequency
%
70
60
50
40
30
20
10
0
1
2
3
4
5
> 5
ng I-TEq(NATO(CCMS) / kg fat
cage
n=20
ground
n=10
field
n=21

Figure 2


PCDD/F-profiles in eggs from foraging and caged chicken
60
50
40
30
20
10
1
OCDD
Sum HpCDD
Sum HxCDD
Sum PCDD
Sum TCDD
OCDF
Sum HpCDF
Sum HxCDF
Sum PCDF
Sum TCDF
foraging 1
foraging 2
foraging 3
caged