CHARACTERISTIC OF PCDD/Fs LEVELS IN PORK CONSUMED IN KOREA

Choi SW[1], Kim SY[1], Kim M[2], Kim DG[2], Yun SJ[2], Her M[1]

[1]Seoul Regional Office, National Veterinary Research and Quarantine Service, San23-4 Deungchon-2-dong Gangseo-gu, Seoul, 157-843, Korea; [2]National Veterinary Research and Quarantine Service, #480 Anyang-6-dong, Manan-gu, Anyang, Gyeonggi-do, 430-824, Koera

Introduction

Available data on emissions, environmental and food levels, and human body burdens of dioxins indicate a several-fold reduction in exposures and body burdens since 1970[1], suggesting that efforts to control dioxin emissions and to reduce exposures be successful.[2] In Korea, the similar trend is expected from the data reported by MOE that the dioxin emissions from incinerators have been reduced by about 80% for last three years.[3] US EPA has estimated that more than 90% of the remaining human exposures to dioxins occur through food consumption, primarily from animal fat.[4] According to the previous study by Kim et al.(2003)[5], targeting PCDD/Fs levels in most consumed meat in Korea – beef, pork, chicken, the contribution of pork is higher than of other two items, even though the actual level is not significant. In the light of amount, the domestic consumption of pork tends to increase every year quite much that 27.75 g/person/day in 1988 has come up to 47.34 g/person/day in 2004.[6] The above situations give us strong motive to monitor the dioxin levels in pork domestically consumed in Korea, the survey result of which is reported and discussed as below.

Materials and Methods

To determine levels of PCDD/Fs in pork consumed in Korea, 60 domestic samples and 30 imported samples were collected through the year of 2005. The size and the sites for domestic pork samples were set based on the distribution of raised pigs across the country. Imported pork samples were selected randomly by AIIS (Automated Import Information System). Fat was extracted from the samples in the oven under 80℃. The analysis was based on the Isotope dilution method on US EPA 1613B protocol. Extraction and Clean-up were performed using Power-Prep™ (FMS Inc., USA) after spiking C-13 labeled standards for checking recoveries. 37-Cl clean-up standard was added to test the efficiency of the clean-up step, and matrix blank was accompanied considering the accidental contamination during the whole procedure. The extract was concentrated to 50 μl and analyzed by HRGC/HRMS (Autospec Ultima, Micromass, UK). The capillary column DB5MS (60m×0.25mm I.D., 0.25um film thickness, J&W Scientific, USA) was used for separating compounds on GC.

Results and Discussion

The mean concentration of each congener of PCDD/Fs is presented in Table1., which is compared with the data reported in the previous study [5] For TEQ values, WHO-TEF (98) was applied, and non-detects were assigned to zero. FDA has stated that assuming non-detects are equal to LOD/2 or LOD is likely to overestimate exposure to dietary PCDD/Fs and setting them equal to zero (i.e., including only values actually measured) provides more realistic dietary intake estimates.[8] Total PCDD/Fs showed noticeable reduction from 8.29 to 4.82 pg/g fat, showing the worldwide tendency of decreasing dioxin levels in food.[1,2,9] PCDDs took 78% of the total concentration, an increased ratio, compared with 53% in 2002.[5] Almost every Penta, Hexa, Hepta-CDD except 1,2,3,6,7,8-HCDD was detected with elevated levels, but TCDD was not detected, same as in 2002. The compound with the highest concentration is OCDD, like in the previous study, but the actual level was decreased quite much. While the levels of Hexa and Hepta-CDFs were lower, those of the two penta-CDFs were higher than those in the study of 2002. On the whole, in spite that relatively toxic compounds such as penta-CDD/Fs were detected with higher concentrations, both of total PCDD/Fs levels and the TEQ values were reduced by about 40%. One feature seen in Fig.1 describing contribution of PCDDs vs. PCDFs to TEQ and non-TEQ levels is that the amount of PCDDs detected in the pork is larger than that of PCDFs in both of the studying year, but in the respect of TEQs, the opposite trend can be seen, which means congeners of PCDFs contributed to the total toxicity much more either in the number or in the level. However, with the decrease of TEQ from the year of 2002 to 2005, the level of PCDFs also became lower as can be seen in Fig.2 showing the contribution of PCDDs vs. PCDFs to the TEQ levels in domestic and imported pork. Judging from the PCDDs and PCDFs levels in Table 1, it will be more appropriate explanation of the trend that PCDFs levels were reduced than that PCDDs levels were increased. Larger contribution of PCDFs to TEQs in the pork samples in 2005 is due to substantial amount of those in domestic pork, even though the ratio is definitely smaller than that of 2002, as can be seen Fig.2. The reason for it cannot be known because the collection of samples have diverse sources and properties in terms of environment and feeding stuffs. One of the probable factors is that feeding stuffs with the additives containing PCDFs with high toxicity levels, such as fish meal, fish oil, animal fat, shell powder might be consumed, assuming from the result of the study of animal feed and feed additives in Korea in 2004.[10] For clearing the causes and taking proper measures to lower PCDFs in domestic pork, further study of feeding stuffs and environment exposed to domestically raised pigs is needed.

To find out the trend of dietary intake through pork consumed in Korea, net pig meat supply and annual pork self-sufficiency were referred to Food Balance Sheet.[6] For summing out the dietary intake over the year of 2002, the data corresponding to the sampling period were available, but for the current survey, the alternatives of 2004 were used because the information of 2005 is not available yet. 45.21 g/person/day of net pig meat supply, 96.9% of annual pork self-sufficiency in 2002, and 47.34 g/person/day, 87.4% in 2004 were reported respectively.[6] PCDD/Fs TEQ levels for domestic and imported pork were multiplied with average fat content

(W/W) of 21% for domestic pork and 36% for imported one[7], and then, calculated with the above applicable data to attain the outcome of 2.17 TEQ pg/person/day for the year of 2002 and 1.21 TEQ pg/person/day for 2005 as annual dioxin intake through pork. Divided with 60kg average body weight, 0.04 TEQ pg/kg b.w/day for the year of 2002 and 0.02 TEQ pg/kg b.w/day for 2005 were estimated to be average influx from pork consumed in Korea, which indicates remarkable decrease in the levels of PCDD/Fs in dietary pork. To be sure whether it to be a good reward or not for the strenuous effort to cut the dioxin exposure to livestock, more systematic and integrating study including any and every potential element affecting the PCDD/Fs levels is required

Table 1. Levels of PCDD/Fs (pg/g fat) in pork consumed in Korea in 2005 compared with the study in 2002[5]

YEAR / CONGENER	2005	2002	YEAR / CONGENER	2005	2002
2378-TCDF	0.00	0.00	2378-TCDD	0.00	0.00
12378-PeCDF	0.04	0.01	12378-PeCDD	0.13	0.00
23478-PeCDF	0.12	0.07	123478-HxCDD	0.26	0.07
123478-HxCDF	0.14	0.36	123678-HxCDD	0.01	0.03
123678-HxCDF	0.07	0.28	123789-HxCDD	0.09	0.00
234678-HxCDF	0.03	0.23	1234678-HpCDD	1.20	0.84
123789-HxCDF	0.16	0.20	OCDD	2.06	3.44
1234678-HpCDF	0.32	1.48	**PCDD**	**3.75**	**4.38**
1234789-HpCDF	0.07	0.28	PCDD/Fs	4.82	8.28
OCDF	0.13	1.00	(PCDD/Fs) TEQ	0.11	0.18
PCDF	**1.07**	**3.90**			

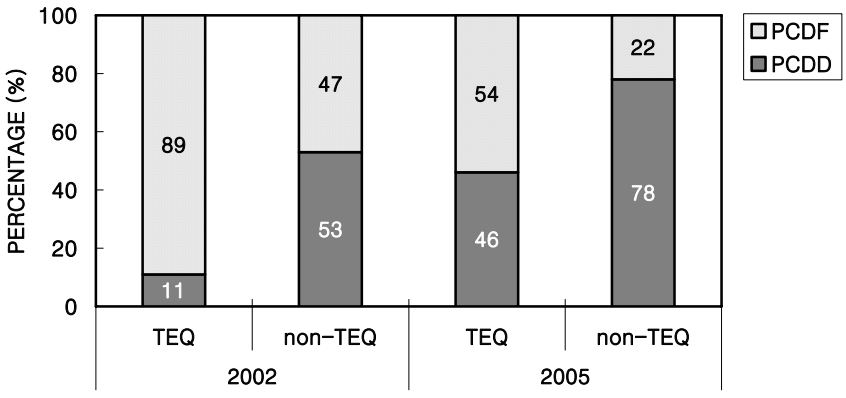

Fig.1. Contribution of PCDDs vs. PCDFs to TEQ and non-TEQ levels in pork consumed in Korea.

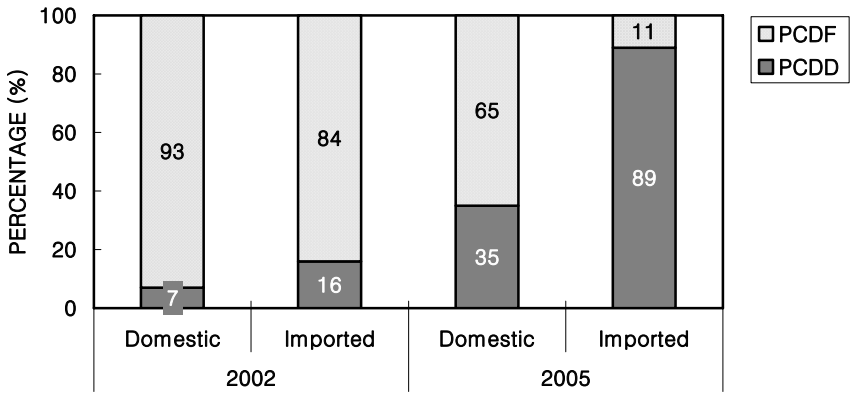

Fig. 2. Contribution of PCDDs vs. PCDFs to the TEQ levels in Domestic and Imported pork.

References

1. Hays SM., Aylward LL. *Regulatory Toxicology and Pharmacology* 2003;37:202~217

2. Charnley G., Doull J. *Food and Chemical Toxicology* 2005;43:671~672

3. Ministry of Environment Proposal of Dioxin emission inventory 2005

4. US EPA Exposure and human health reassessment of 2,3,7,8-TCDD and related compounds. National Academy of Sciences Review Draft, National Center for Environmental Assessment, Office of Research and Development, Washington DC., 2004

5. Kim M, Kim SY, Yun SJ, Cho BH, Lee MH, Son SW, Park JM. *Organohalogen Comp* 2003;64: 9~12

6. Korea Rural Economic Institute Food Balance Sheet; 2004: 168~169

7. Kim SY, Chae KR, Kim WS, Lee SH, Jung DW, Kim HS, Yoon CS, Jung HS, Yoon TY, Kim JS. *Organohalogen Comp* 2005;67:1435~1436

8. US FDA PCDD/PCDF Exposure Estimates, Center for Food Safety and Applied Nutrition, Office of Plant and Dairy Foods, 2004

9. EU SCOOP, Assessment of dietary intake of dioxins and related PCBs by the population of EU Member States, 2000

10. Kim M, Kim SY, Kwon JW, Kim DG, Son SW. *Organohalogen Comp* 2005:1492~1494