DIOXINS AND FURANS IN VEGETABLE OILS SOLD IN COLOMBIA

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Introduction

Dioxins (PCDD) and furans (PCDF) are persistent organic pollutants unintentionally generated in different processes. Nevertheless, not all of these compounds have the same toxicity in humans. Congeners with chlorine substituted in the four lateral positions (2,3,7 and 8) have demonstrated to be most toxic[1]. All of these high persistent compounds are able to experience bioaccumulation and biomagnification, and easy access to different levels of the food chain[2,3]. Over 90 percent of human exposure to dioxins is through food intake, mainly meat, dairy products, fish and seafood. Unfortunately, in Colombia there is not control over the maximum levels of PCDD/ Fs in food products. The aim of this study was to make a preliminary assessment of the risks posed by PCDD/Fs in different foods sold in Colombia. Here, we report on PCDD/ Fs results for several vegetable oil samples.

Materials and methods

Sample treatment

Oil samples (olive, fish and soybean) were purchased in a local supermarket in Medellín-Colombia. All samples were spiked with known amounts of standard mixtures of ^{13}C- PCDD/Fs EPA-1613 LCS and dioxin-like ^{13}C-PCBs WP-LCS. Then, they were treated with 100 mL of sulphuric acid and after 5–6 h the organic phase was removed with 150 mL of n-hexane. Finally, the *n*-hexane extracts were rotary concentrated. The cleaned-up process was carried out using glass columns filled with acidic/basic silica gel, florisil and basic alumina as adsorbents. This procedure is outlined in figure 1. Finally, the extracts were concentrated, transferred to vials and spiked with ^{13}C- PCDD/Fs EPA-1613 ISS and ^{13}C-PCBs WP-ISS standards for the analysis.

GC–MS Instrumentation

Samples were analyzed by High Resolution Gas Chromatography coupled to High Resolution Mass Spectrometry (HRGC-HRMS) on a Gas Chromatograph (Thermo Fisher Scientific, Milan, IT) fitted with a 60 m x 0.25 mm i.d. x 0.25 μm film thickness DB-5ms fused silica column (J&W Scientific, CA, USA) coupled to a High Resolution Mass Spectrometer (DFS, Thermo Fisher Scientific, Bremen, Germany). Quantification of PCDD/Fs and dioxin-like PCBs were performed using the isotopic dilution method according to EPA [4,5]. Relative response factors (RRFs) for each individual 2,3,7,8-chlorosubstituted PCDD/F and dioxin-like PCB congeners were obtained by calibration with standard solutions. Recovery percent of ^{13}C-labelled compounds was calculated from area comparison between LCS and ISS compounds. Toxic equivalents (WHOTEQ) were determined using WHO-TEF factors.

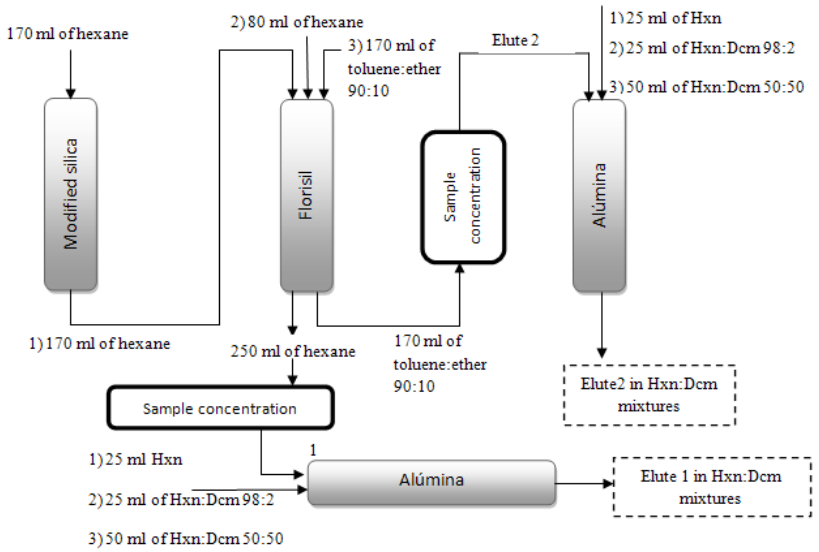

Figure 1. Cleanup procedure for simultaneous analysis of PCDD/Fs and DL-PCBs

Results and discussion

Although there are not established limits in Colombia to control dioxins and furans in food, there is a need to meet export criteria. Therefore, it is necessary to carry out preliminary studies to determine these persistent contaminants in food samples. In this study, we examined samples of: soybean, fish and olive oils. Only two of our samples are produced and marketed in our country, soy oil and fish oil.

Table 1 lists the concentration values of PCDDs/PCDFs expressed in pg/g fat for each congener and in terms of pg/g WHO-TEQ fat. Figure 2 shows mean concentrations of individual PCDD/Fs and PCBs congeners expressed in pg/g of fat. The levels of PCDDs/PCDFs are low with a concentration ranging between 0.25 and 1.51 pg/g WHO-TEQ fat. In this study, we should mention that the recoveries were within 50 to 80%. The highest levels of PCDD/Fs, expressed as the sum the 17 congeners, were found in fish oil with a mean value of 4.71 pg/g fat followed by olive oil and soybean oil. In addition, in terms of total WHO-TEQ concentrations, fish oil also presents the highest mean value 1,51pg WHO-TEQ/g fat and the lowest level was for soybean oil. In general, PCDD/F levels in the oil samples of the present study are low. As listed in Table 1, the concentration of each PCDD/F congener and the sum of PCDD/Fs were below the maximum established by the European Regulation (6 pg WHOTEQ/ g fat for PCDD/Fs) in all cases[6].

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References

1. Fiedler, H. (2007); *Chemos* 67: S96–S108

2. G. McKay. (2002); *Chem Eng J.* 86: 343–368

3. Bordajandi L, Gmez G, Abad E, Rivera J, Fernndez-Bastn M, Blasco J, Gonzlez M. (2004); *J. Agric. Food Chem*. 52(4): 992-1001

4. US Environmental Protection Agency (EPA) Method 1613: Tetra- thorough Octa-chlorinated Dioxin and Furans by Isotope Dilution HRGC/HRMS, Revision A, 1990.

5. US Environmental Protection Agency (EPA) Method 1668: Chlorinated Biphenyl Congeners in Water, Soil, Sediment, Biosolids and Tissue by HRGC/HRMS, Revision A, December 1999.

6. Commission Directive 2006/13/EC of 3 February 2006 amending Annexes I and II to Directive 2002/32/EC of the European Parliament and of the Council on undesirable substances in animal feed as regards dioxins and dioxin-like PCBs. Off. J. Eur. Union L32, 44–53.

Table 1 Mean concentrations of individual PCDD/Fs and PCBs congeners and total WHO-TEQ values (upperbound), expressed in pg/g of fat in different commercial oil samples in Medellín-Colombia

Compound	Soybean Oil	Olive Oil	Fish Oil
2378-TCDD	0,008	0,046	0,697
12378-PeCDD	0,112	0,065	0,181
123478-HxCDD	0,049	0,070	0,199
123678-HxDD	0,075	0,085	0,189
123789-HxCDD	0,049	0,096	0,252
12346789-HpCDD	0,298	0,145	0,406
OCDD	1,205	0,446	0,627
2378-TCDF	0,063	0,103	0,194
12378-PeCDF	0,130	0,092	0,568
23478-PeCDF	0,035	0,133	0,616
123478-HxCDF	0,188	0,113	0,629
123678-HxCDF	0,194	0,158	0,500
234678-HxCDF	0,211	0,168	0,464
123789-HxCDF	0,031	0,130	0,361
1234678-HpCDF	0,736	0,487	0,869
1234789-HpCDF	0,811	0,226	0,416
OCDF	0,515	0,310	0,549
∑ PCDD/Fs	4,710	2,873	7,717
WHO-TEQ (PCDD/Fs)	0,250	0,280	1,510

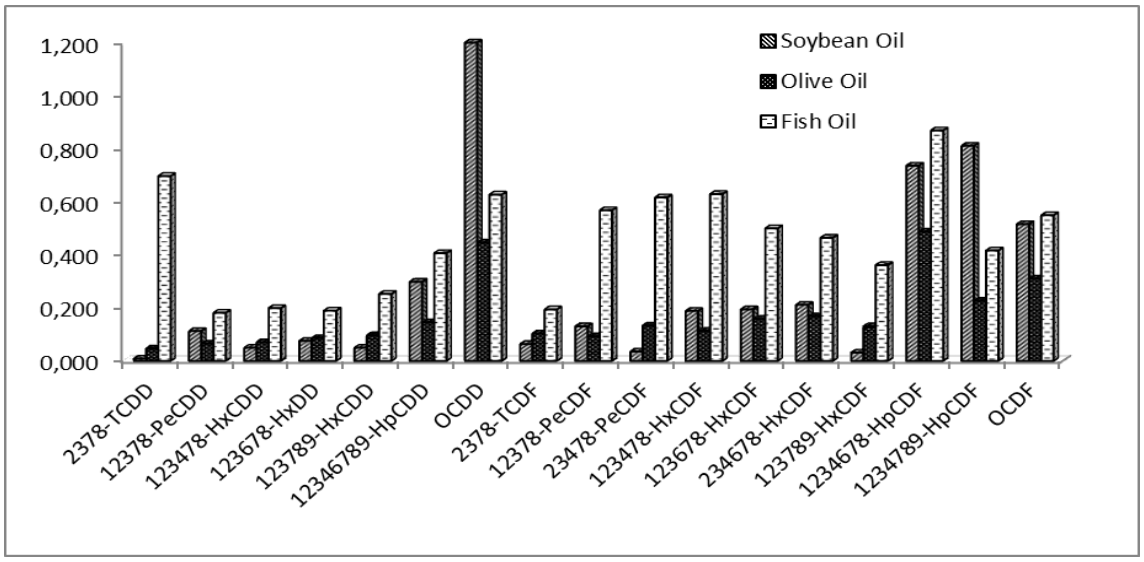

Figure 2 Graphic mean concentrations of individual PCDD/Fs and PCBs congeners expressed in pg/g of fat