# PCDD/FS AND WHO-PCBS IN NUTRITIONAL SUPPLEMENTS SOLD ON TAIWAN MARKET

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## Introduction

Muscle meat of fish and fishery products contributes the most (ca. 46%) to the mean estimated monthly intake in Taiwan's first total diet study[1]. Generally, popular nutritional supplements such as fish oil capsules were not included in a typical TDS study. We have therefore conducted a survey of PCDD/Fs levels in fish oil sold on Taiwan market in year 2001[2]. Among the 10 fish oil samples, only one is above the EU maximum level 2 pg WHO-$TEQ_{PCDD/Fs}$/g fat. Considering the dioxin-like PCBs, i.e., the 12 WHO-PCBs are scheduled to be included in the calculation of TEQ on the coming November, we have broadened the samples to be surveyed. Namely, a total of 17 samples includes 12 fish oil capsules (9 shark liver extract, 2 fish body oil, and 1 cod liver extract), 2 sea seal oil capsules, 2 barley green powder, and 1 napier grass powder. The grass-base powder was included as napier grass (a feed ingredient for local cattle during winter time) was found to be the cause of elevated dioxin levels in cow milk during winter season. Imported barley green powder was selected for comparison purpose. An evaluation of the impact of the new EU maximum levels upon these nutritional supplements was attempted.

## Materials and Methods

The 12 fish oil capsules, 2 sea seal oil capsules, and 3 grass-base nutritional powder samples were collected in year 2005. The samples were popular brands and readily available. The analyzed oil was collected by removing the cover of the capsules, weighted and recorded. About 5 grams test portions were used. The samples were pre-treated and analyzed using the Chinese National Standard (CNS) method of test for residual dioxins and dioxin-like PCBs in foods (CNS 14758). Samples were analyzed for 17 toxic PCDD/Fs and 12 PCBs designated by WHO. Detailed analysis conditions were reported in an earlier study[1]. One test of method blank was carried out for every eight samples. The matrix spiking test and duplicate matrix spiking test were also run for every eight samples. The recoveries of 17 PCDD/Fs congeners lie in the range of 70% to 130% for all matrices. The variations of duplicate analysis were within 30%. The toxic equivalents (TEQ) were calculated using WHO-PCDD/F-TEF. The concentration of the not detected congeners was calculated with the limit of determination, i.e., represented as upperbound concentration.

## Results and Discussion

The TEQ levels of 17 PCDD/Fs and 12 WHO-PCBs in each sample are listed in Table 1. All samples were found to contain PCDD/Fs. Taiwan Department of Health has recently established the maximum limit for PCDD/Fs in fish oils intended for human consumption, which is similar to the European legislation's maximum limit (Council Regulation 2375/01/EC No 466/2001) of 2 pg WHO-PCDD/F-TEQ/g fat. Compared to PCDD/Fs limit, 4 out of 14 fish oil capsules and 1 out of 2 sea seal oil capsules were above the EU's maximum limit. If TEQ form WHO-PCBs was taken into consideration, only l capsule was below EU's maximum limit. The TEQ ratio of WHO-PCBs to PCDD/Fs ranges from 1.2 to 5.6 with an average of 3.45. For grass-base nutritional supplements,

the TEQ levels of 17 PCDD/Fs were relatively low. The TEQ levels of WHO-PCBs were not analyzed as in a previous study of 6 napier grass powder samples the TEQ from WHO-PCBs was about 0.18 to that of PCDD/Fs. The PCBs contribution to total TEQ was considered insignificant in these grass-base powder samples. The representative TEQ profiles of PCDD/Fs and WHO-PCBs are shown in Fig. 1 and Fig 2, respectively.The profiles might provide additional information about the origin of these pollutants. Research towards this direction is currently undergoing.

**Acknowledgements**
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**References**

1. A total diet study to estimate PCDD/Fs and dioxin-like PCBs intake from food in Taiwan, M.S. Hsu, K.Y Hsu, S.M. Wang, U. Chou, S.Y. Chen, N.C. Huang, C.Y. Liao, T.P. Yu,Y.C. Ling. Chemosphere. Accepted.
2. Survey of PCDD/Fs Levels in Fish Oil Sold on Taiwan Market, C. F. Chang, M. S. Hsu, C. H. Jone, E. Ma, and Y. C. Ling

Table 1. Sample information, TEQ of PCDD/Fs and WHO-PCBs(pg-WHO-TEQ/g fat), and TEQ ratio of PCBs to PCDD/Fs .

| Sample ID | Matrix | $TEQ_{PCDD/Fs}$ | $TEQ_{PCBs}$ | $TEQ_{PCDD/Fs+PCBs}$ | PCDD/Fs/PCBs |
|---|---|---|---|---|---|
| A | SLE | 3.53E+01 | 1.52E+02 | 1.87E+02 | 4.3 |
| B | SLE | 3.17E-01 | 1.48E+01 | 1.51E+01 | 4.7 |
| C | SLE | 4.77E+01 | 2.68E+02 | 3.16E+02 | 5.6 |
| D | SLE | 2.20E-01 | 4.66E+01 | 4.68E+01 | 2.1 |
| E | SLE | 2.26E+00 | 7.22E+00 | 9.47E+00 | 3.2 |
| F | SLE | 3.08E-01 | 4.29E+01 | 4.32E+01 | 1.4 |
| G | SLE | 2.08E-01 | 2.49E+00 | 2.70E+00 | 1.2 |
| H | SLE | 1.03E+00 | 5.29E+00 | 6.32E+00 | 5.1 |
| I | SLE | 7.93E-01 | 3.21E+00 | 4.00E+00 | 4.0 |
| J | FBO | 4.33E-01 | 1.21E+01 | 1.26E+01 | 2.8 |
| K | FBO | 3.96E-01 | 1.38E+00 | 1.78E+00 | 3.5 |
| L | CLO | 2.60E+00 | 1.11E+01 | 1.37E+01 | 4.3 |
| M | SSO | 6.59E-01 | 1.99E+00 | 2.65E+00 | 3.0 |
| N | SSO | 2.16E+00 | 8.93E+00 | 1.11E+01 | 3.4784615 |
| O | BG | 1.04E-01 | NA | NA | NA |
| P | BG | 1.34E-01 | NA | NA | NA |
| Q | NG | 1.76E-01 | NA | NA | NA |

SLE: Shark Liver Extract; FBO: Fish Body Oil; CLO: Cod Liver Oil; SSO: Sea Seal Oil; BG: Barley Green; NG: Napier Grass.

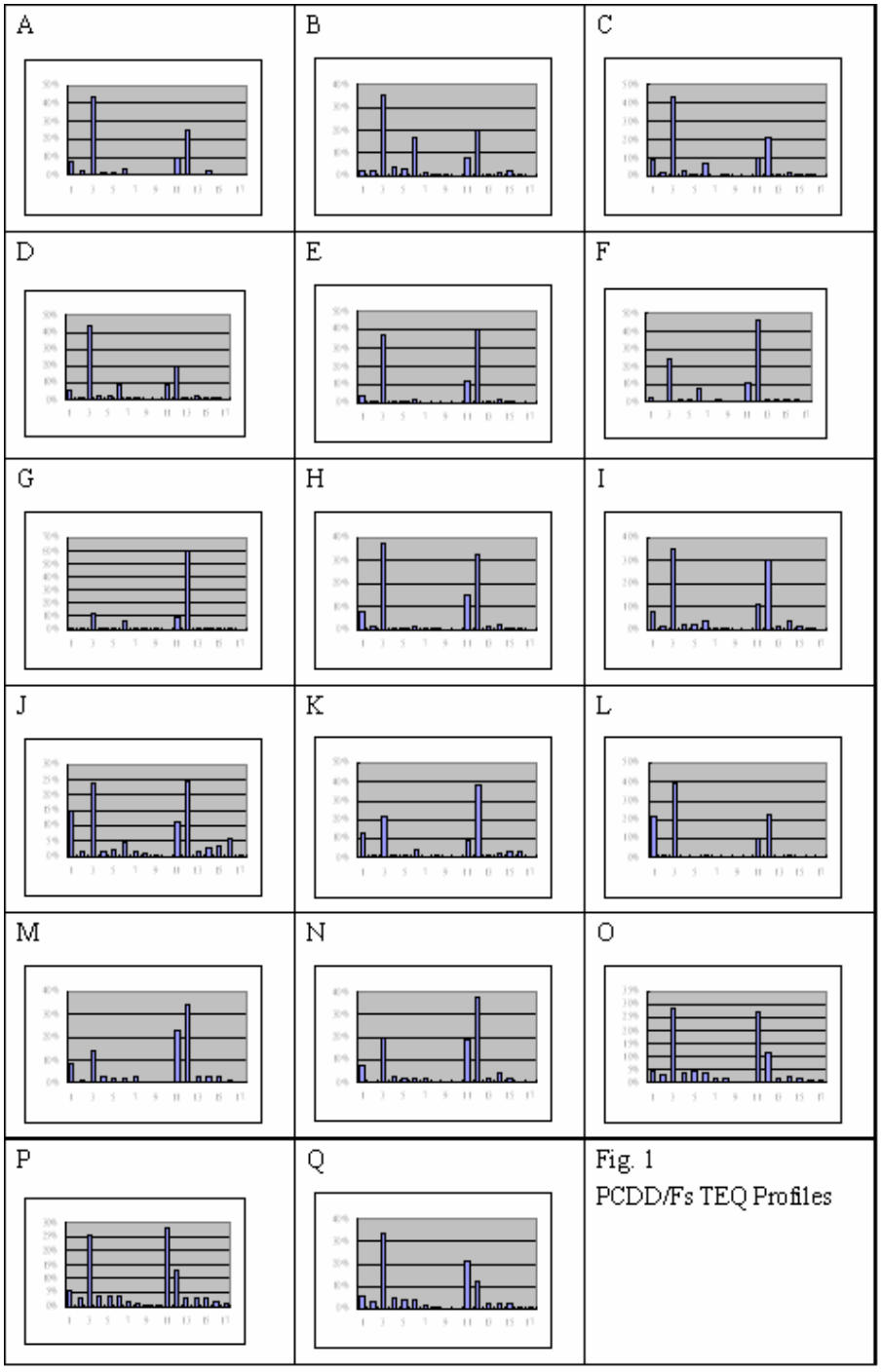


Fig. 1
PCDD/Fs TEQ Profiles

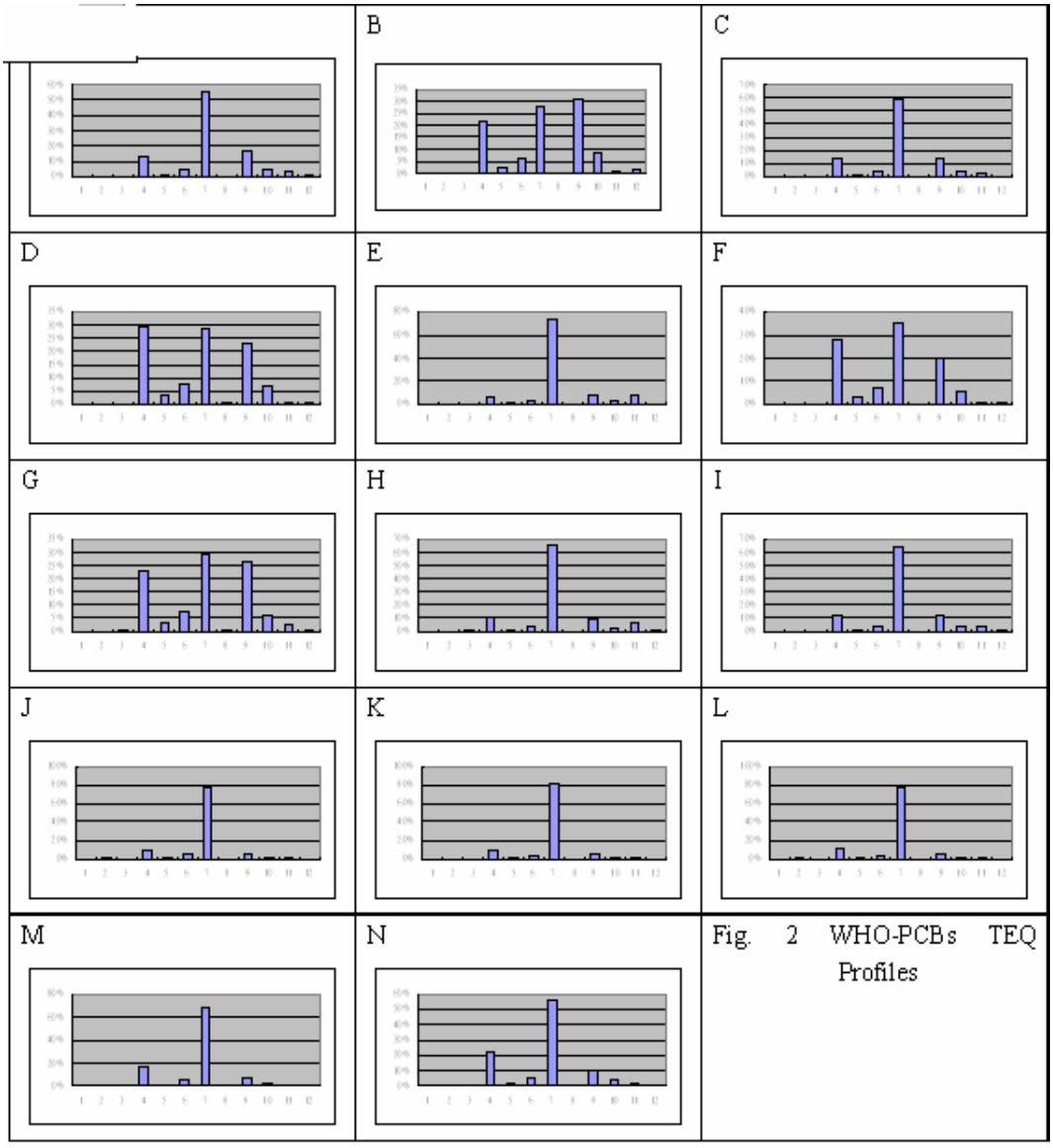


Fig. 2 WHO-PCBs TEQ Profiles