

Health risk assessment of Butyltin intake from seafood in Taiwanese

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Introduction

Tributyltin and triphenyltin (TBT and TPhT) are used as antifouling paints owing to their strong biocide activity toward the aquatic organisms such as mollusks ⁽¹⁾. Many studies have showed TBT and TPhT are endocrine disruptors which at very low concentration (1 ng/L in water) will cause “imposex” ⁽²⁾, the imposition of the male characteristics in females of some gastropods. Organotin compounds can also enter the food chain through bioaccumulation of marine organisms destined for human consumption, such as oyster, farmed salmon, mussels, calms ⁽³⁾.

This study was conducted to carry out a survey of six organotins (TBT, DBT, MBT, MPhT, DPhT and TPhT) background levels in 200 fishery products. This study further conducts the risk assessment of organotins from dietary intake by the newest National Health and Nutrition Examination Survey data, and provides a risk communication document for general population.

Materials and methods

The fishery products were collected from fishery markets of the northern, southern, eastern and central Taiwan. The six organotins (TBT, DBT, MBT, MPhT, DPhT and TPhT) in fishery products will be analyzed with GC/MS. Finally, the analytical data and fishery products uptake data will be used to estimate the non-carcinogenic effects expressed as hazard index (HI) for general population.

Results and discussion

Two hundred samples including 64 freshwater fishes, 80 saltwater fishes, 16 crustaceans, 20 bivalves/univalve crustaceans, 20 ammonites were collected in markets. The most abundant butyltin was found in the saltwater fish in all of the samples with a mean level of 0.251 (0.010-1.70)mg/kg fresh weight, followed by freshwater fish: 0.176 (0.015-1.03), crustacean: 0.126 (0.010-0.621), bivalves/univalve: 0.109 (0.015-0.307), and ammonites: 0.080 (0.008-0.493)(Table 1). The most abundant phenyltins was found in the crustacean in all of the samples with a mean level of 0.920 (0.012-3.06) mg/kg fresh weight, followed by bivalves/univalve: 0.448 (0.052-1.38), ammonites: 0.300 (0.009-1.19), freshwater fish: 0.242

(0.009-1.36), and saltwater fish: 0.235 (0.009-2.27).

It's well-known that both tributyltin and triphenyltin are immunotoxicity but lacks of significant evidence of carcinogenic effect ⁽⁴⁾. Therefore, non-cancer hazard quotient (HQ, the ratio of exposure level to the reference dose) and the hazard index (HI) were used to evaluate the potential health risk. The hazard indices(HI) of TBT+DBT were over 1 in 0~3, 3~6, and 6~12 male age group, which reveal that it is probably cause deleterious health effects during lifetime exposure (Table 2).

The average of daily dietary intake of fish and shellfish referred from Belfroid's study ⁽⁵⁾ was used to estimate the tolerance level of tributyltin and triphenyltin in seafood. As a result of the EFSA has established a group TDI of 0.25 µg/kg bw for TBT, DBT, TPT and DOT compounds. We used the EFSA's TDI to estimate the daily dietary intake. The Tolerable average residue levels(TARLs) for 0~3 yrs is 307 ng Sn/g wt, 3~6 yrs is 322, 6~12 yrs is 241, 12~16 yrs is 563, 16~18 yrs is 788, 19~65 yrs is 295 and above 65 yrs is 342. There are 62 samples over the TARLs, which includes 17 freshwater fish samples range from 264 to 1425 ng Sn/g wt. Although most of the measured fishery products are safe to eat, some fish are still necessary for continuous monitoring to avoid eating the organic-tin contaminated fishes.

Acknowledgements

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References

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Table 1 6 species of organotin levels in seafood (wet basis)

Fishery food	N	TBT	DBT	MBT	MPhT	DPhT	TPhT	SBTs	SPhTs
Fresh water fish	64	0.021 (ND-0.189)	0.059 (ND-0.525)	0.097 (ND-0.697)	0.049 (ND-0.429)	0.047 (ND-0.273)	0.145 (ND-1.34)	0.176 (0.015-1.03)	0.242 (0.009-1.36)
Saltwater fish	80	0.021 (ND-0.203)	0.103 (ND-1.40)	0.128 (ND-0.798)	0.025 (ND-0.150)	0.122 (ND-2.25)	0.089 (ND-0.773)	0.251 (0.010-1.70)	0.235 (0.009-2.27)
crustacean	16	0.009 (ND-<0.040)	0.036 (ND-0.191)	0.081 (ND-0.583)	0.208 (<0.009-1.19)	0.039 (ND-0.231)	0.673 (ND-2.81)	0.126 (0.010-0.621)	0.920 (0.012-3.06)
bivalves/ univalve	20	0.027 (ND-0.158)	0.051 (ND-0.255)	0.031 (ND-0.080)	0.143 (ND-0.449)	0.139 (ND-0.689)	0.166 (<0.025-0.854)	0.109 (0.015-0.307)	0.448 (0.052-1.38)
ammonites	20	0.014 (ND-0.073)	0.045 (ND-0.381)	0.023 (ND-0.109)	0.111 (ND-0.610)	0.099 (ND-0.627)	0.089 (ND-0.341)	0.080 (0.008-0.493)	0.300 (0.009-1.19)

註：1. concentration levels: mg/kg fresh weight。

2. <MDL, shown as "ND"; >MDL but < LOQ, shown as <LOQ (mg/kg)

3. the average levels was calculated as 1/2 MDL; >MDL but <LOQ, shown as 1/2 LOQ

Table 2 No-carcinogenicity risk assessment of organotin for Taiwanese through seafood intake for specific age groups

	Freshwater fish (n=64)	Saltwater fish(n=80)	crustacean (n=16)	bivalves/unival ve (n=20)	ammonites (n=20)	Total(n=200)
TBT(mg/kg fresh weight)	0.021	0.021	0.009	0.027	0.014	0.02
HQ(TBT)	0.09	0.09	0.04	0.11	0.06	0.08
TBT+DBT(mg/kg fresh weight)	0.080	0.124	0.045	0.078	0.059	0.092
HQ(TBT+DBT)	0.33	0.51	0.19	0.32	0.24	0.38
TPT(mg/kg fresh weight)	0.145	0.089	0.673	0.166	0.089	0.161
HQ(TPT)	0.60	0.37	2.77	0.68	0.37	0.66
TBT+DBT+TPT(mg/kg fresh weight)	0.225	0.213	0.718	0.244	0.148	0.253
HI(TBT+DBT+TPT)-0~3 y	0.26	0.65	0.26	0.04	0.02	1.2
HI(TBT+DBT+TPT)-3~6 y	0.22	0.45	0.82	0.17	0.04	1.7
HI(TBT+DBT+TPT)-6~12 y-male	0.12	0.43	0.43	0.10	0.06	1.1
HI(TBT+DBT+TPT)-6~12 y-female	0.12	0.36	0.37	0.12	0.06	1.0
HI(TBT+DBT+TPT)-12~16 y -male	0.12	0.17	0.29	0.03	0.03	0.6
HI(TBT+DBT+TPT)-12~16 y-female	0.05	0.14	0.22	0.04	0.02	0.5
HI(TBT+DBT+TPT)-16~18 y -male	0.09	0.13	0.12	0.03	0.03	0.4
HI(TBT+DBT+TPT)-16~18 y-female	0.04	0.09	0.14	0.02	0.02	0.3
HI(TBT+DBT+TPT)-19~65 y-male	0.16	0.37	0.37	0.05	0.04	1.0
HI(TBT+DBT+TPT)-19~65 y-female	0.15	0.36	0.30	0.06	0.03	0.9
HI(TBT+DBT+TPT)>65 y-male	0.18	0.45	0.06	0.03	0.02	0.7
HI(TBT+DBT+TPT)>65 y-female	0.16	0.36	0.05	0.02	0.01	0.6

Note : the age groups were categorized by 「 The National Intake Bank of Taiwan: <http://intakes.nhri.org.tw/food-intake-data/> 」