

出國報告（出國類別：國際會議）

參加 2015 國際持久性毒性物質研討會 報告

服務機關：行政院環境保護署環境檢驗所

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摘要

自工業革命以來，科學技術逐漸發達，改善人類生活品質是許多科學家的願望，因此許多物質被合成創造新功能，或提煉作為特殊用途；但因欠缺生態環境安全影響評估或受限當代知識之考量，以致某些化合物雖達成其特殊功效，但也對生態環境造成重大影響，如早期使用之有機氯殺蟲劑 DDT、阿特靈與地特靈等，被用於增進農業生產及環境病媒-跳蚤、瘧蚊等之防治，功效卓著；但後來被發現其在環境中不易分解，具生物累積性，甚至部分藥劑具致癌性，會經由食物鏈的生物濃縮而累積於生物體內，干擾內分泌，降低繁殖能力或引起病害，間接引起某些物種之滅絕。這些造成環境問題的污染物，稱為持久性有機污染物（persistent organic pollutants, POPs），特性有四點，第一：具有化學穩定性、持久性、不易分解；第二：可揮發但揮發性不太高，且會在不同環境中出現；第三：可通過生物食物鏈（網）累積；第四具有高毒性。有機污染物的「持久性」，是指在自然環境中，不容易分解和轉變，因而有機會在不同環境中，長期存在和四處擴散。除了持久的特性外，這些污染物因水溶性和可揮發性不高，釋放於自然環境中後，僅有一小部分溶解於水中或揮發在空氣中。因此在不同環境中，例如大氣、海洋、河川、土壤和生物體內，都可發現它們的蹤影。除了上述的化學特性外，會造成環境問題的污染物還對動、植物具有毒性，且會在生物體內累積，對人體健康和生態系產生不良的影響。因此這些造成環境問題的污染物，也常稱為持久性毒性物質（persistent toxic substance, PTS）。許多生活周遭廣泛使用的日常用品，如塑膠、染料、清潔劑、化妝品、電器等，均有添加持久性毒性物質。於是這些化學物質成為目前全球性重要的環境問題，更引起國際間的重視，並促成跨國的合作和協議。目前聯合國環境規劃署已將其中 26 種 POPs 列為管控重點，並推動國際公約(即斯德哥爾摩公約)，要求各國必須採取行動，減少環境中該等物質之殘留量，進而確保食品之安全。此 26 種 POPs 包括阿特靈(Aldrin)、可氯丹(Chlordane)、滴滴涕(DDT)、地特靈(Dieldrin)、安特靈(Endrin)、飛佈達(Heptachlor)、六氯苯(Hexachlorobenzene)、滅蟻樂(Mirex)、毒殺芬(Toxaphene)、 α -六氯環己烷(α -HCH)、 β -六氯環己烷(β -HCH)、十氯酮(Chlordecone)、靈丹(Lindane)、五氯

苯(Pentachlorobenzene)、安殺番(Endosulfan)、戴奧辛(Dioxin)、呋喃(Furans)、多氯聯苯(PCBs)、六溴二苯醚和七溴二苯醚(HexaBDE & HeptaBDE)、四溴二苯醚和五溴二苯醚(TetraBDE & PentaBDE)、六溴聯苯(Hexabromobiphenyl)、全氟辛烷磺酸(PFOS)及其鹽類和全氟辛烷磺醯氟(PFOF), 及 2015 年 5 月召開第 7 次締約方大會新增列管之 3 種物質, 六氯丁二烯(Hexachlorobutadiene)、氯化萘(Chlorinated naphthalenes)及五氯酚(Pentachlorophenol)及其鹽、酯類。

我國透過「毒性化學物質管理法」、「環境用藥管理法」、「農藥管理法」及相關法規等行政手段嚴格管制或禁限用公約列管之 POPs。另外為瞭解國內持久性有機污染物在環境中流布狀況, 本署逐批進行特定環境介質(如污染性河川地區)之流布調查, 憑藉著管理整合以往各單位之相關研究成果, 以逐步建立持久性有機污染物環境流布基本資料, 可知政府目前採取行政管制及主動管理兩種策略推動 POPs 之危害評估及預防工作, 防患危害於未然。

當然, 不能以此自滿, 推動持久性有機污染物管理以符合聯合國環境規劃署斯德哥爾摩公約管制趨勢為政府重要工作之一, 所以對於 2015 年 5 月召開第 7 次締約方大會新增列管之 3 種物質: 六氯丁二烯(Hexachlorobutadiene)、氯化萘(Chlorinated naphthalenes)及五氯酚(Pentachlorophenol)及其鹽、酯類, 持續關注其相關法規及檢測方法之訂定, 以應用在國內環境調查之研究。此外大會有相當數量論文以阻燃劑(PBDEs)為主題發表, 本所對此議題並不陌生甚至已有良好基礎, 早在 2006 年即針對國內部分河川底泥、魚體及港灣底泥進行多溴二苯醚採樣檢測(李慈毅, 2006), 建議密切關注國際間對此等議題之探討及方法開發, 有效應用在國內相關議題之研究。

再者, 目前研討會論文分布主要是以環境流布類調查, 其次是毒理學探討為主, 顯示環境流布類及毒理探討類議題已相當成熟。建議同仁可關注持久有機物焦點問題, 此類議題較新, 未來較易取得成果, 並應用在國內民生議題之研究。

最後, 要多與世界接軌, 「他山之石, 足以攻錯」期望本署及所內同仁有機會參與第 13 屆(2016 年)國際持久性毒性物質研討會或其他類似會議(如國際含鹵持久性有機污染物), 發表論文吸收先進經驗, 或邀請國際學者來台演講分享經驗。

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壹、目的

許多生活周遭廣泛使用的日常用品，如塑膠、染料、清潔劑、化妝品、電器等，其組成中有一些化學物質容易釋放到環境中而四處擴散，卻不易在環境中自然地分解。於是這些化學物質成為目前全球性重要的環境問題，更引起國際間的重視，並促成跨國的合作和協議。例如不同地區的一百多個國家，針對 12 種持久性有機污染物 (persistent organic pollutants, POPs)，聯合簽署了斯德哥爾摩公約，並於 2004 年 5 月 17 日正式生效實施，以便對這些持久性有機污染物進行管制。因為持久性有機污染物具有跨洲和長距離傳輸的特性，不是局限於小地域或單一國家的污染，因此需要全球各地區國家的共同參與，才能有效地達到減少這些污染物擴散的目的。目前聯合國環境規劃署已將其中 26 種 POPs 列為管控重點，並推動全球性之持久性有機污染物斯德哥爾摩公約 (Stockholm Convention on Persistent Organic Pollutants，簡稱 POPs 公約)，要求各國必須採取行動，減少環境中該等物質之殘留量，進而確保食品之安全。我國自 2004 年起依據「環境基本法」及「國家環境保護計畫」，以環境教育、環境調和及預防性誘因工具為主軸，釐定臺灣「環境保護施政三年行動計畫」，針對公約列管物質，規劃並制訂相關法令及政策

環境污染向來為國人重視之民生問題，我國目前已透過「毒性化學物質管理法」、「環境用藥管理法」、「農藥管理法」及相關法規嚴格管制或禁限用公約列管 POPs，此外，因應世界潮流，對於持久性有機污染物檢測技術也投入相當多之資源，期能達到與世界同步。基於此，104 年本所派職參加第 12 屆(2015)國際持久性毒性物質研討會(The 12th International Symposium on Persistent Toxic Substances, ISPTS)，於美國洛杉磯加州大學河濱分校舉辦的研討會，會議中各國專家會就個人研究之突破技術進行論文發表及討論，可即時獲取相關經驗，並利用參與此研討會之機會，蒐集相關研究主題及分析技術，作為未來本所發展持久性毒性物質檢測及分析技術之規劃，有助本所前瞻性檢測技術之提升。

貳、過程

一、行程紀要

第 12 屆(2015)國際持久性毒性物質研討會(The 12th International Symposium on Persistent Toxic Substances, ISPTS)於 2015 年在美國洛杉磯加州大學河濱分校(University of California, Riverside, CA)之 Highlander Union Building 舉行，會期自 11 月 16 日至 11 月 20 日，共計 5 日。

日 期	地 點	工作說明
104 年 11 月 14-15 日	桃園國際機場至美國洛杉磯	啟程
104 年 11 月 16-21 日	加州大學河濱分校	出席第 12 屆(2015)國際持久性毒性物質研討會
104 年 11 月 22 日	美國洛杉磯至桃園國際機場	返程

二、會議紀要

本次會議採分組、分類的方式同時進行，包括大會演講、分組演講、壁報論文報告、廠商儀器展示等項同時進行，相關相片如附件一。11 月 16 日至 17 日為大會會議，內容包括 17 篇大會演講、92 篇口頭論文報告和 117 篇壁報論文，口頭論文分別於 5 間會議室同時進行，進行方式使用 Power Point 進行 30 分鐘簡報，然後 5 分鐘提問，壁報展示同時於大會議廳共同展示，已擇其重要論文 1 篇回國進行心得分享(如附件二)，並將研究論文資料以壁報方式發表(如附件三)。整體而言，大會安排流程緊湊而順暢，議程及論文題目如附件四。

三、本次會議論文內容及涵蓋主題

會議針對 6 大主軸進行討論：包括(一)、持久性污染物(PTS)的環境行為；(二)、持久性污染物(PTS)的毒理性質研究；(三)、持久性污染物(PTS)的焦點

問題；(四)、持久性污染物(PTS)的風險評估；(五)、持久性污染物(PTS)的整治；(六)、持久性污染物(PTS)的化學分析及生物分析的技術檢測技術開發等。

大會口頭論文涵蓋廣泛，兩天專題會議共分為 11 場，

第一天議題如下：

SESSION 1: Emerging PTS of concern (持久性污染物《PTS》的焦點問題)

SESSION 2: Sources, transport and fate of PTS (持久性污染物《PTS》的環境行為)

SESSION 3: Toxicology of PTS (持久性污染物《PTS》的毒理性質研究)

SESSION 4: Metals and Organometallic Compounds (金屬和有機金屬化合物)

SESSION 5: Risk Assessment and Remediation (持久性污染物《PTS》的風險評估)

SESSION 6: New Approaches for Linking Chemical Exposure to Human Health Outcomes (環境暴露對人體傷害)

第二天議題如下：

SESSION 1: Sources, Transport and Fate of PTS (持久性污染物《PTS》的環境行為)

SESSION 2: Toxicology of PTS (持久性污染物《PTS》的毒理性質研究)

SESSION 3: Nanomaterials in the Environment (環境中的奈米物質)

SESSION 4: Risk Assessment and Remediation (持久性污染物《PTS》的風險評估)

SESSION 5: Analytical and bioanalytical methods (持久性污染物(PTS)的化學分析及生物分析的技術檢測技術開發)

參、心得

本次參加於美國洛杉磯加州大學河濱分校舉辦的第 12 屆(2015)國際持久性毒性物質研討會(ISPTS)，演講大會論文報告演說及規劃程序相當緊湊精彩，分為大會演講、口頭論文報告和壁報論文，礙於時間及場次安排僅能擇自己有興趣之主題參加聽講，無法一一參與各場次之精采演說，心得內容包括 1 篇大會演講、4 篇口頭論文及 1 篇壁報論文，內容如下：

一、大會演講-化學污染物和城市水系統的第四次革命

(**Chemical contaminants and the fourth revolution in urban water systems**)

作者：D. Sedlak

單位：Department of Civil and Environmental Engineering, University of California, Berkeley, CA 94720, U.S.A. (sedlak@berkeley.edu)

本研究指出，歷史上城市的擴張必須要有管理城市水資源循環的新方法，這些新方法的出現往往是因為，當現有的供水技術不再能夠達到保護公眾健康和確保水資源來源的目標，公眾將會意識到需要供水系統的改變。人口暴增，氣候變遷，現有設備不足等因素都是創建城市供水系統中的第四次革命的因素。有必要將當前不適合用於飲用水使用的（例如，廢水流出物，城市徑流）水源進行開發。此外，人們日益認識到微量有機污染物在水生生態系統的影響，所以重新思考城市污水處理和雨水的分類管理。積極的以先進的水處理系統去除化學污染物，環境化學家可以提供更具彈性和有效的供水系統進行改革。

二、口頭論文報告

(一) **Micropollutants in the deep, big ocean**

作者：R. Lohmann

單位：Graduate School of Oceanography, University of Rhode Island, South Ferry Road, Narragansett, RI 02882, USA (rlohmann@uri.edu)

本研究指出在 1989/1990，全球進行第一次研究多氯聯苯 (PCBs) 和其他持久性有機污染物 (POPs) 在開放海域的傳輸，透過理論預測（通過淨沉積）多氯聯苯將以氣-水交換方式進入大西洋。從陸地逕流和大氣沉降得知，顯示 POPs 主要傳輸途徑是經透過大氣進到水體。當多氯聯苯進入海水的混和層，會透過生物代謝傳輸到深層海水；全氟烷基 (PFAS) 的傳輸機制則還不清楚。在最近一份研究北極冰洋/大西洋表面到深層的海水剖面檢測多氯聯苯 (PCBs) 和全氟烷基 (PFASs) 的研究結果，明確的顯示這些持久性有機污染物到海水深層的運輸模式。對於離子態的 PFASs，中性的持久性有機污染物可以沉降到深海，或逸散到大氣中。多氯聯苯和有機氯農藥（但不包括多環芳香烴 PAH）的水-氣交換梯度顯示污染物由海水逸散到大氣中。在北極冰洋/大西洋及太平洋均有相似的結果。在過去十年間，大西洋的表層海水中的多

環芳香烴 PAH 濃度未有明顯改變。總體而言，持久性有機污染物在全球海洋的分布型態是複雜的，但更多的證據顯示持久性有機污染物（POPs）會從海水表面逸散到大氣中。本研究可供未來進行全球海水中持久性有機污染物（POPs）檢測趨勢參考。



圖 1、演講會場

(二) Toxicological characterization of water disinfection byproducts - halobenzoquinones

作者：J. Li, K. Fu, S. Vemula, W. Wang, X.F. Li

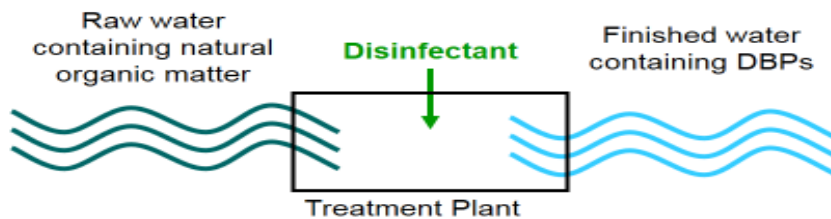
單位：Division of Analytical and Environmental Toxicology, Faculty of Medicine and Dentistry, University of Alberta, Edmonton, Canada (xingfang.li@ualberta.ca)

飲用水加氯消毒所衍生的消毒副產物(DBPs)，會造成膀胱癌的風險增加。由於飲用水使用普遍，消毒副產物的鑑定已經成為一個非常重要的研究課題，並且是需要加以解決的問題。經過動物致癌研究證據顯示，受管制的消毒副產物（例如，三鹵甲烷，三鹵乙酸）不如我們想像的那樣會增加癌症風險。本研究顯示 HBQs(halobenzoquinones)具有潛在致癌的高度細胞毒性和遺傳毒性，經化學分析證實當水中消毒副產物濃度在 ng/L 等級，HBQs 就廣泛發生。定量結構毒性分析(Quantitative structure toxicity relationship, QSTR)發現 HBQs 具有高度毒性和潛在的致癌性。在體外細胞毒性實驗證明

HBQs 會比消毒副產物 DBPs 誘發更大的細胞毒性或更高的發育毒性。細胞反應機制顯示 HBQs 會產生活性氧 (ROS)，耗盡細胞的穀胱甘肽 (glutathione)，並抑制細胞抗氧化酶，導致對細胞蛋白質和 DNA 的進一步損害。對 DNA 的氧化損傷反應在 8-hydroxydeoxyguanosine (8-OHdG 的)，DNA 鏈的細胞顯著受損，和嘌呤/嘧啶 (AP) 位點。HBQs 也會形成 DNA 加合物，影響 DNA 甲基化基因組，並抑制 DNA 修復酶。研究顯示 HBQs (halobenzoquinones) 具有潛在致癌的高度細胞毒性和遺傳毒性。

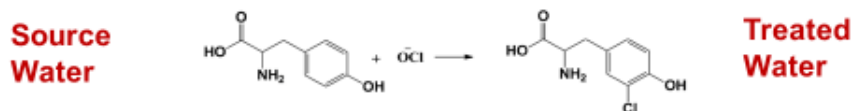
Disinfection Byproducts (DBPs)

- Disinfection is critical to prevent water-borne diseases
- DBPs are formed when the disinfectant reacts with naturally occurring organic matter in raw water

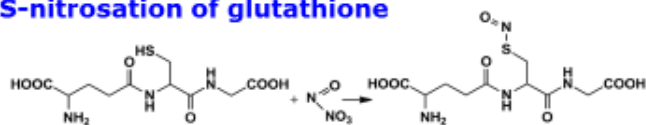


Identification of *In Situ* Disinfection Reactions during Chlorination

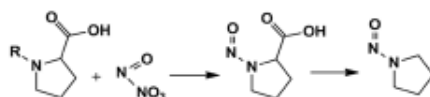
1. Chlorination of tyrosine



2. S-nitrosation of glutathione



3. N-nitrosation of proline

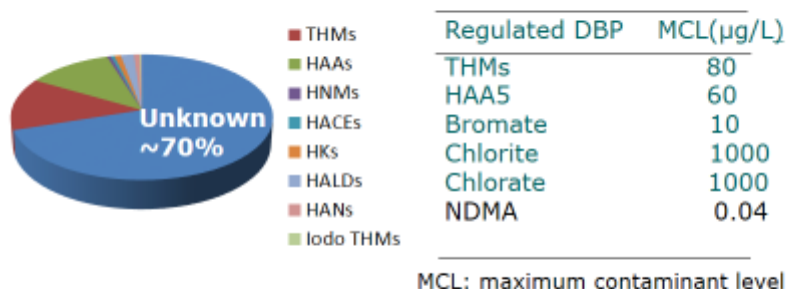


34

圖 2、水處理廠產生的消毒副產物 (DBPs) 成因與部分產物

Motivations

1. Majority of DBPs are unknown



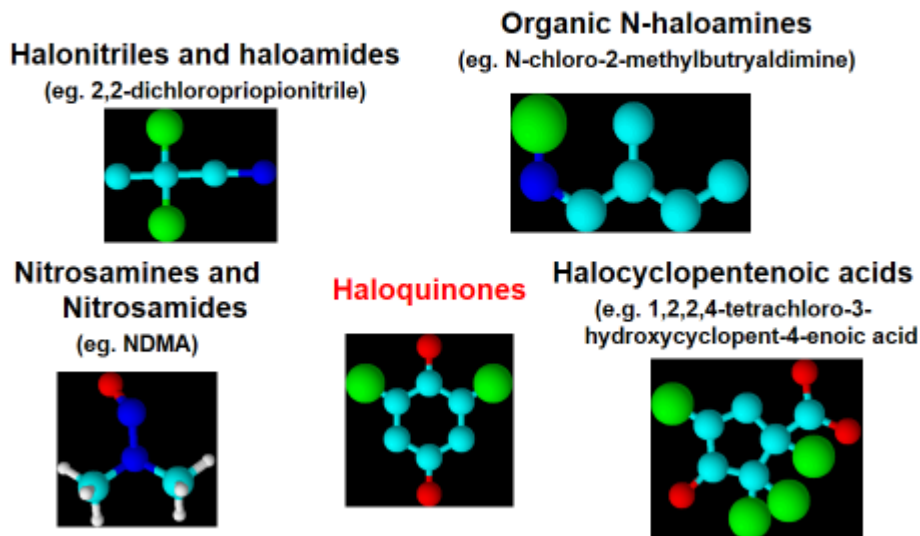
2. Knowledge Gap in DBPs and Cancer Risk?

Richardson, S.D. *Anal Chem.* **2011, 2014**

9

圖 3、已知與未知消毒副產物(DBPs)比例與致癌風險評估

Quantitative Structure and Toxicity Relationship (QSTR) Analysis Predicts Target DBPs



Bull and Reckhow, 2006 WRF report

圖 4、使用定量結構毒性分析 (Quantitative structure toxicity relationship, QSTR) 找出主要消毒副產物(DBPs)

Analytical Characterization of HBQs

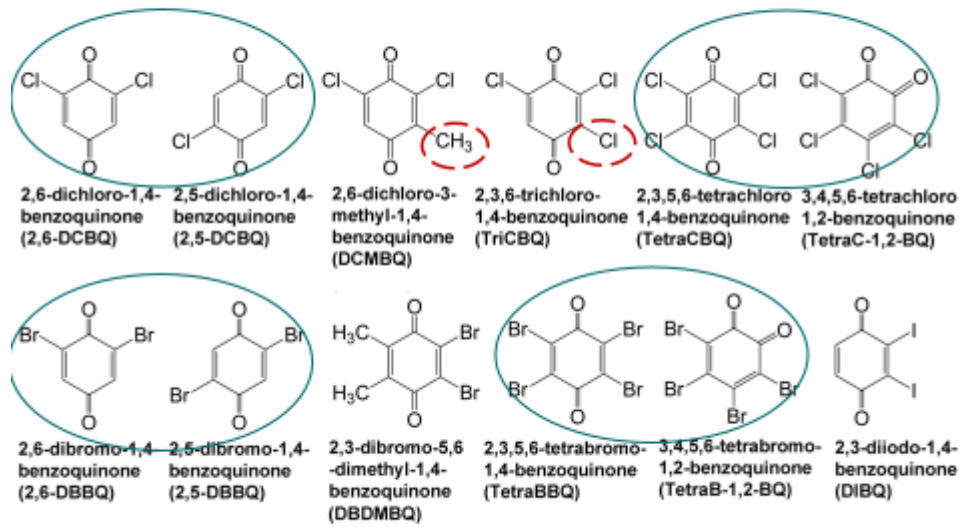
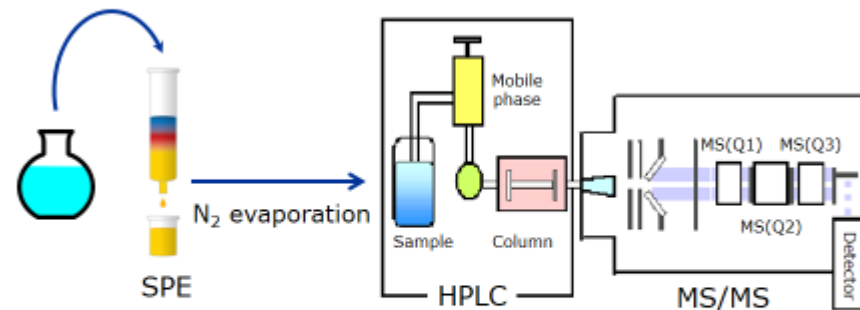
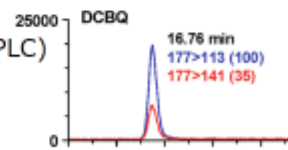


圖 5、HBQs(halobenzoquinones)種類

Analytical method: SPE-UHPLC-MS/MS



Solid phase extraction (SPE)
High performance liquid chromatograph (HPLC)
Mass spectrum (MS)
Multiple reaction monitoring (MRM)

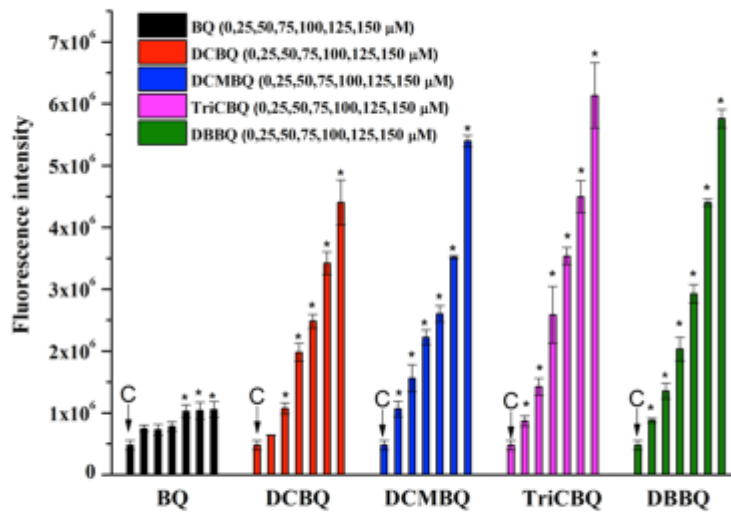


MRM spectrum

19

圖 6、本研究分析方法

HBQs induced ROS generation in T24 cells



ROS generation induced by HBQ in T24 cells using DCFHDA assay.

BQ, benzoquinone. N=6

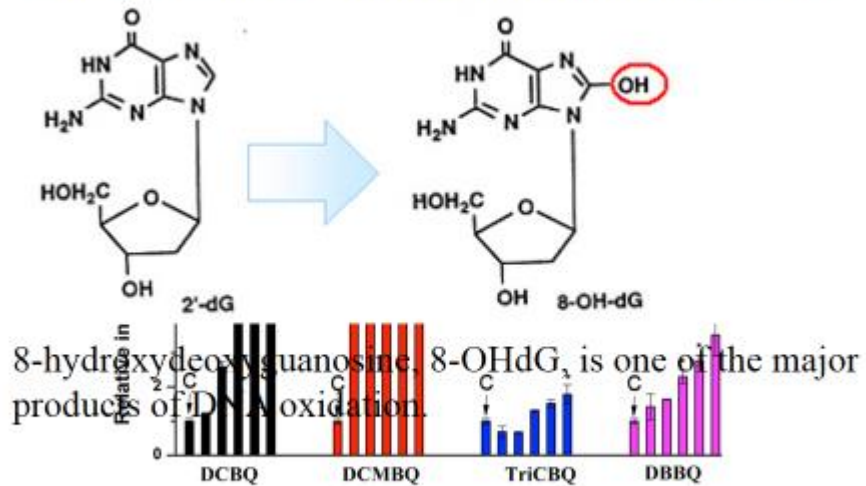
* $P < 0.05$, treatment groups of HBQs compared to their respective control group

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圖 7、HBQs 的細胞反應機制結果-1

Marker of oxidative DNA damage

HBQs induced 8-OHdG generation in T24 cells



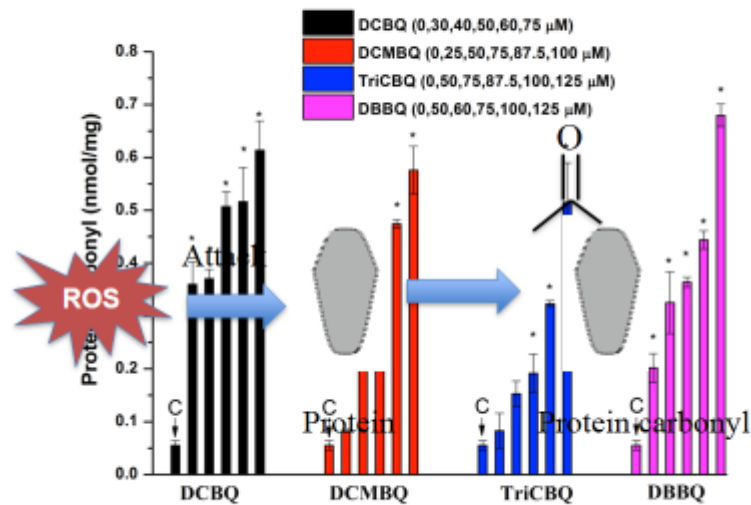
8-hydroxydeoxyguanosine, 8-OHdG. C, indicates the negative control. * $P < 0.05$, treatment groups of HBQs compared to their respective control group. N=6

35

圖 8、HBQs 的細胞反應機制結果-2

Marker of oxidative protein damage

HBQs induced formation of protein carbonyl in T24 cells



C, indicates the negative control. * $P < 0.05$, treatment groups of HBQs compared to their respective control group. N=6

37

圖 9、HBQs 的細胞反應機制結果-3

(三) ADVERSE OUTCOME PATHWAY DEVELOPMENT FOR selenomethionine and hypersaline toxicity in the Japanese Medaka

作者：A.J. Kupsco,¹ D. Schlenk²

單位：¹ Environmental Toxicology Program, University of California, Riverside, CA 92521, U.S.A. (akups001@ucr.edu); ² Environmental Sciences, University of California, Riverside, CA 92521, U.S.A.

當採礦和農業活動造成土壤被擾動，土中富含硒元素(Se)並會釋放到水道。雖然硒是一種必需的微量營養素，但卻會造成魚類產生胚胎毒性及產生畸形。Selenomethionine (SeMet) 是硒經過轉換的有機模式。隨著氣候變化加劇海平面上升正在增加。在某些河口造成鹽度變化。鹽度改變可能不會對成魚致死的直接影響，但可能會改變生物排毒策略。作者已經證實鹽度降低會降低日本青鱗魚 (Japanese Medaka) 孵化率，增加 Selenomethionine (SeMet) 強度並且造成畸胎。我們先前確定 Selenomethionine 暴露在階段 25 (受精後 48 小時) 中 24 小時是最易受鹽度變化增強毒性。這項研究的目的是調查 SeMet 和鹽度變化相互作用影響分子機制之間的不良後果途徑 (AOP)。實驗材料使用日本青鱗的胚胎，淡水是用含有 5 μM 的 SeMet 和聖華金河谷 (San Joaquin River Valley) 的鹽水，實驗方式為階段 25 (受精後 48 小時)，至少持續 24 小時。初步數據顯示會造成細胞

凋亡和氧化應激(oxidative stress)及誘發胚胎畸形。

Selenium

34 78.96
Se
SELENIUM

• Essential micronutrient
• toxic in excess

• Aquatic Exposure:
• Runoff from mining waste, tilled arid soils, coal burning power plants

• Teratogenic

• High Bioaccumulation Factor

Water

TTF_{bird}

TTF_{fish}

$TTF_{invertebrate}$

K_d

Stewart et al., 2004

圖 10、Se 造成魚體發育畸形

Salinity and Selenium in the San Francisco Bay Delta

- Historical Se contamination in SF Bay Delta
- Naturally saline waters
- Increased salinization of fresh waterways
- May impact reproductive success

SELENIUM CONCENTRATIONS IN THE NORTH BAY FOOD CHAIN

DIVING DUCKS (10-40 ppm)
FISH (5-20 ppm)
PRIMARY CONSUMERS: Mussels & Clams (0-8 ppm) Bivalves (5-20 ppm)
PRIMARY PRODUCERS (microphytes, bacteria) 0.5 - 2 ppm

RMP, 2015

圖 11、舊金山灣受鹽度及 Se 影響

Selenomethionine and Hypersalinity

- SeMet is the major source of Se in fish diet (Phibbs et al., 2011)
- SeMet is oxidized by flavin-containing monooxygenases (FMO) (Krause et al., 2006)
- Osmotic stress is also able to induce FMOs in euryhaline fish (Schlenk et al., 2003)

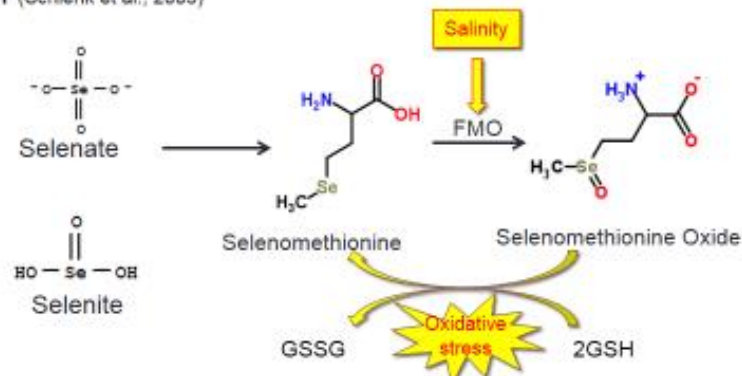


圖 12、SeMet 才是主要污染物

Objective and Hypothesis

- Determine localization of SeMet and hypersaline effects
- SeMet treatment under hypersaline conditions at stage 25 generates oxidative stress, the UPR and apoptosis in the tails of Japanese medaka embryos

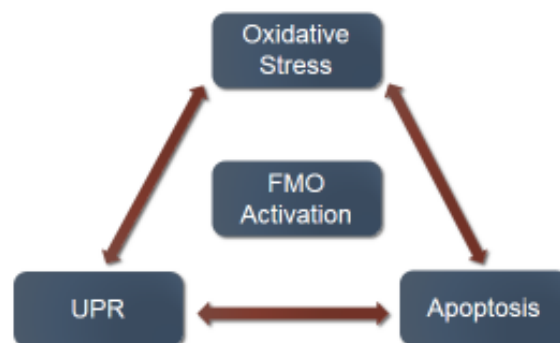


圖 13、實驗設計

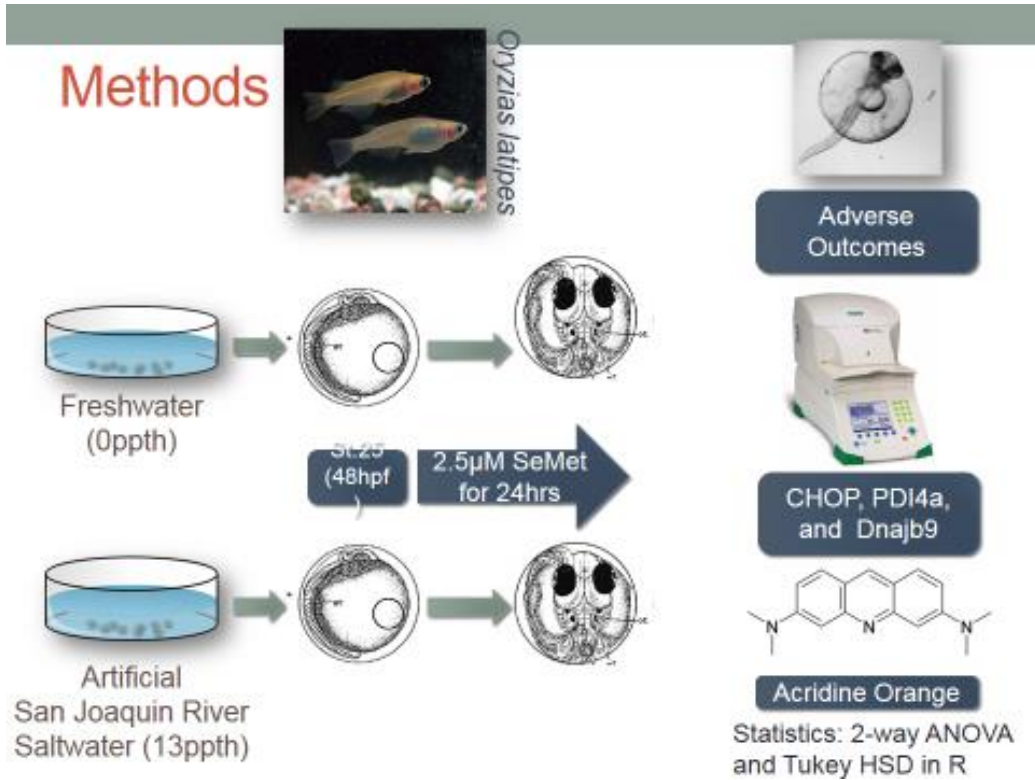


圖 14、實驗設計 2

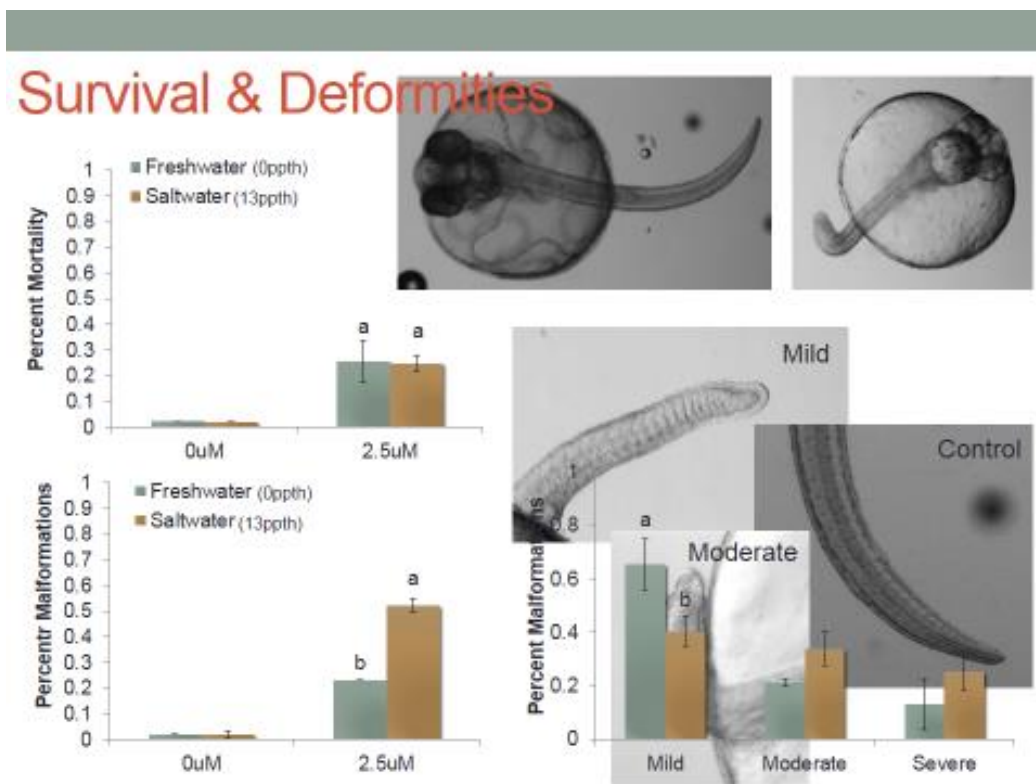


圖 15、實驗結果顯示鹽度及 SeMet 對青鱗魚成長的影響

(四) Stem cell toxicology: A powerful tool to assess bisphenol A derivatives' toxicity

作者：N. Yin,¹ X. Yao,¹ Z. Qin,¹ F. Faiola¹

單位：¹State Key Laboratory of Chemistry and Ecotoxicology, Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, Beijing 100085, China (faiola@rcees.ac.cn)

環境毒理學常常遇到新的挑戰，因為持久性污染物不斷有新的發現和檢測出新的毒性。這些新興物質往往造成健康不良影響，需要有傳統的體外分析，還要做動物試驗。幹細胞毒理學上就是一個非常強大的替代方案，一種新的實驗方法。事實上，由於幹細胞具有在體外無限增殖和分化成許多祖細胞和體細胞，可用於急性、發育、器官和功能的毒性測定。此外，該技術使我們能夠快速檢查污染物的潛在危害性，而不需要借助動物實驗。為了驗證幹細胞毒理學系統，本研究採用有毒物質雙酚 A (BPA) 進行實驗，因為雙酚 A (BPA) 會導致內分泌紊亂，及不孕不育，造成生殖系統傷害，行為異常，心臟疾病，糖尿病和肥胖症。通過利用小鼠胚胎幹細胞，以及它們在體外和模擬胚胎發育分化，本研究證實，BPA 是一種發育毒物。此外，通過實施 ESC 分化過程以產生神經外胚層和神經祖細胞，本研究證明了雙酚 A 的神經毒性。在這項研究中，我們還討論了我們的初步幾個 BPA 衍生物的毒性，BPA 衍生物在許多工業過程取代 BPA，但對健康的影響還沒有得到充分確認。結果顯示 BPA 衍生物毒性 BPA 相似。

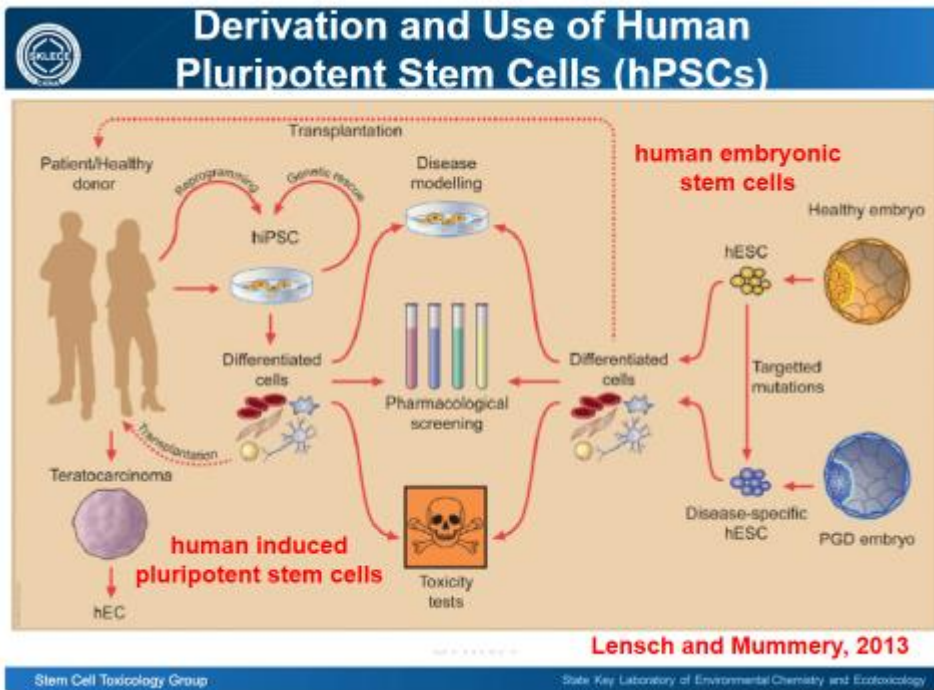


圖 16、幹細胞在毒理學研究的功用

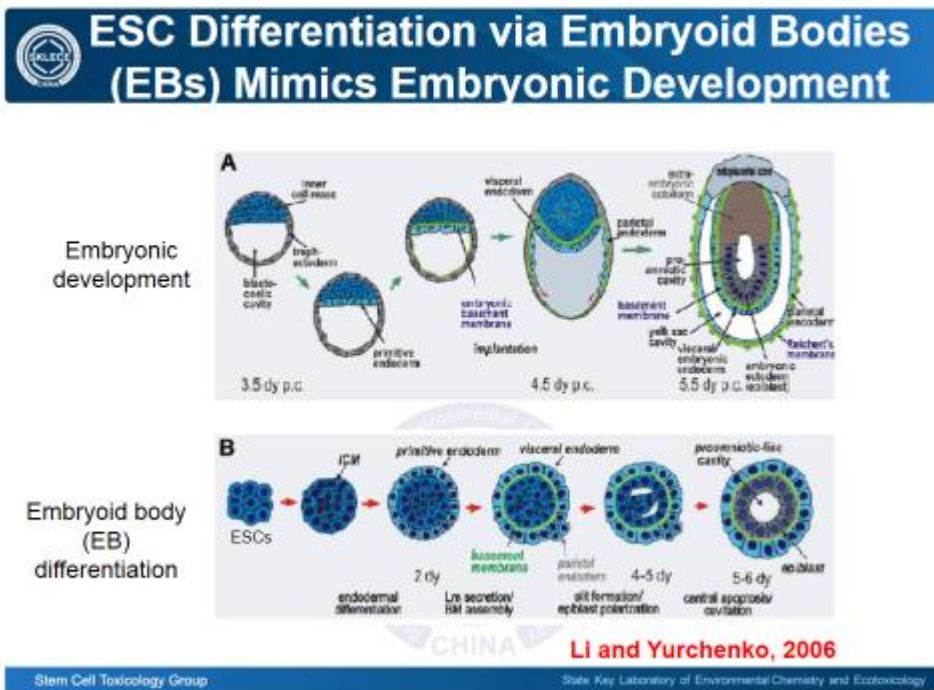


圖 17、胚胎幹細胞的分化及發育過程

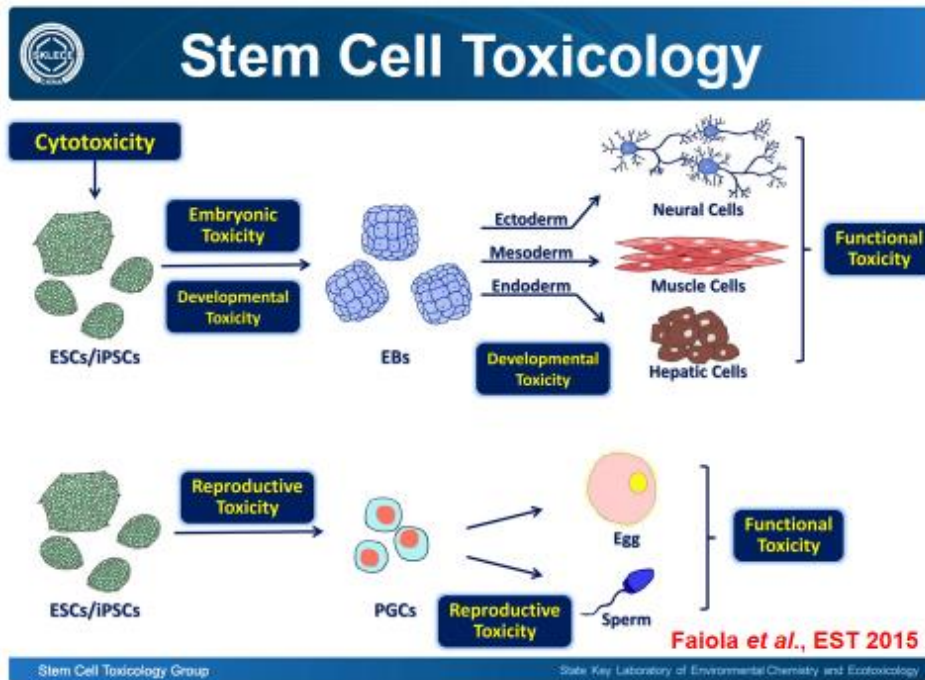


圖 18、胚胎幹細胞的分化、發育過程及毒理學研究

Reproductive Toxicology 42 (2013) 132–155

Contents lists available at ScienceDirect

REPRODUCTIVE TOXICOLOGY

ELSEVIER

journal homepage: www.elsevier.com/locate/reprotox

Review

Bisphenol A and human health: A review of the literature

Johanna R. Rochester*

The Endocrine Disruption Exchange (TEDX), P.O. Box 1407, Denver, CO 81428, United States

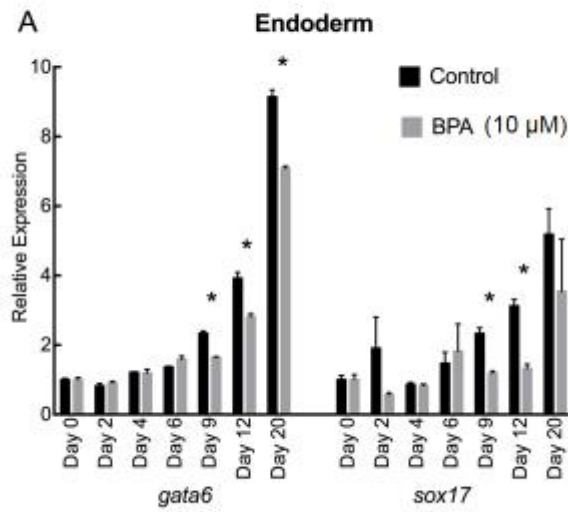
BPA has been associated with many human conditions, including diabetes, obesity, cardiovascular diseases, breast cancer, behavioral troubles.

Stem Cell Toxicology Group
State Key Laboratory of Environmental Chemistry and Ecotoxicology

圖 19 雙酚 A 的毒性(文獻回顧)



BPA Treatment Affects mESC Differentiation into Endoderm



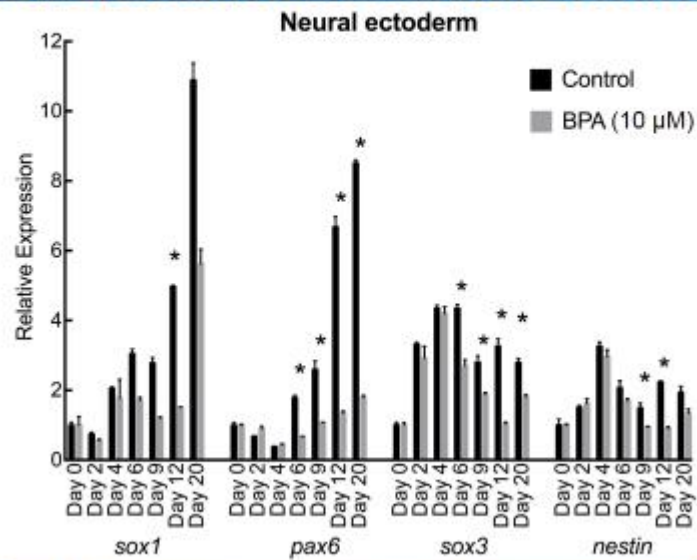
Stem Cell Toxicology Group

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圖 20、小鼠胚胎幹細胞外胚層發育分化結果顯示雙酚 A 的影響



BPA Treatment Affects mESC Differentiation into Neural Ectoderm



Stem Cell Toxicology Group

State Key Laboratory of Environmental Chemistry and Ecotoxicology

圖 21、小鼠胚胎幹細胞神經外胚層發育分化結果顯示雙酚 A 的影響

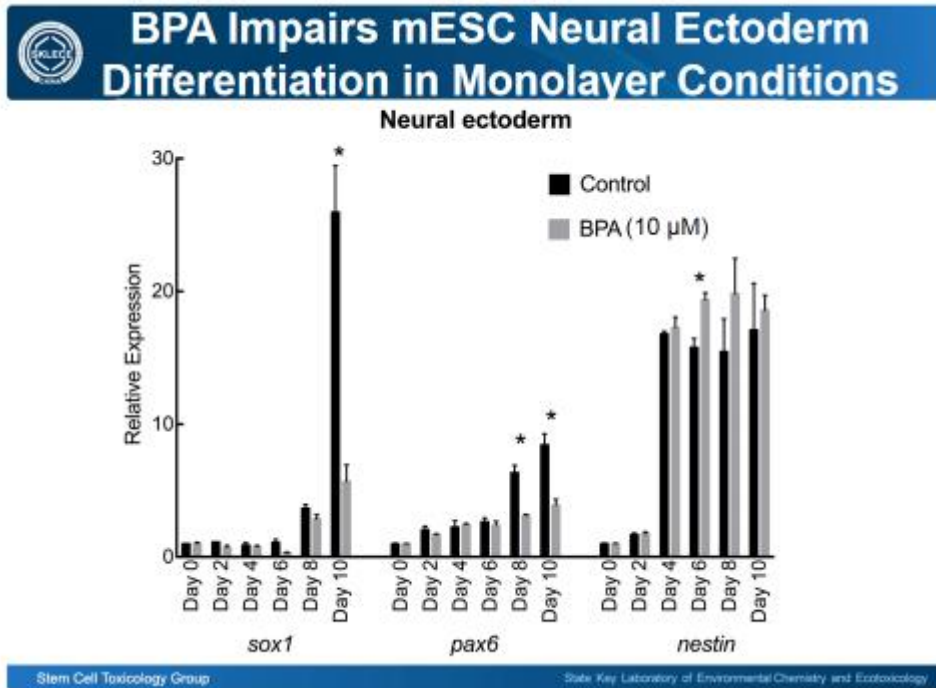


圖 22、小鼠胚胎幹細胞分化遲緩顯示受到雙酚 A 影響

三、壁報論文:

Determination of steroidal estrogens in two STPs and coastal marine water from Jeddah, Saudi Arabia

作者: Mi A. M. Al-Ansari, ¹ D. Chen ²

單位: ¹Department of Environmental Sciences, King Abdulaziz University, Jeddah 21598, P.O.Box 80208, Saudi Arabia (aalansari@kau.edu.sa); ²Department of Zoology, Southern Illinois University, Carbondale, IL 62901, U.S.A.

類固醇雌激素包括 17β -steroidal (E2), 雌酮 (E1), 雌三醇 (E3), 以及 17α 炔雌醇 (EE2) 是內分泌干擾物質 (EDCs) 最顯著的一類, 他們被稱為廢水處理廠 (STP) 各種水生物雌激素活性主要貢獻者和影響生殖健康。雖然自 90 年代初期世界各國在這方面的研究已經獲得了極大關注, 但作者發現在任何阿拉伯海灣國家都沒有進行類固醇雌激素的研究。因此本研究針對, 未經處理的污水 (i) 和兩個污水處理廠的處理污水 (ii) 和在吉達沿海五個站點的地表水, 一共 52 個樣品 (n = 52) 進行了分析。樣品通過固相萃取 (SPE) 濃縮和液相層析 - 串聯質譜法 (LC / MS / MS) 分析。在 KAU 廢水處理廠 (STP) 未經處理的污水 (N = 8) E2, E1, E3 和 EE2 濃度分別為, 9.02, 61.49, 7.71, 3.06 ng/L, 而處理污水 (N = 8) 包含 0.7, 5.3, 0.9, 低於 (<MLOQ) ng/L 定量下限。E2, E1, E3 和 EE2

去除率 92.2%，94.7%，88.3%和 100%。在 Khomra 廢水處理廠 (STP)，雌激素 E2，E1，E3 和 EE2 濃度在進水處 (N = 7) 分別為 1，7.4，22.2，1.4 ng/L 的。雌激素 E1 和 E3 的濃度在廢水處理 (N = 8) 分別為 8 和 3ng/L。E2 和 EE2 是低於 (<MLOQ) ng/L 定量下限。E2，E3，和 EE2 去除效率 100%，E1 去除效率 86.3%，E1 在廢水中濃度較高，暗示較難去除這個雌激素。在所有吉達沿海五個站點的地表水的樣品 (n = 21)，雌激素水平普遍偏低。共有 16 個水樣被測到 E1，其濃度為 0.6 - 5.3 ng/L。3 個水樣被測到 E2，濃度範圍從 0.8 - 1.5 ng/L。從一個站點兩個樣品中檢測到 E3，濃度 0.8 ng/L 和 1 ng/L，EE2 僅檢測到一次濃度 1.9 ng/L。

本論文是第一個針對沙烏地阿拉伯地區類固醇雌激素的研究，研究報告提供兩座污水處理廠和沿海地區水樣類固醇雌激素的數據，並且發現這兩個污水處理廠對類固醇雌激素的高去除率。未來將研究其他環境因素，如稀釋因子，溫度，鹽度的影響或是雌激素降解和微生物活性的影響。

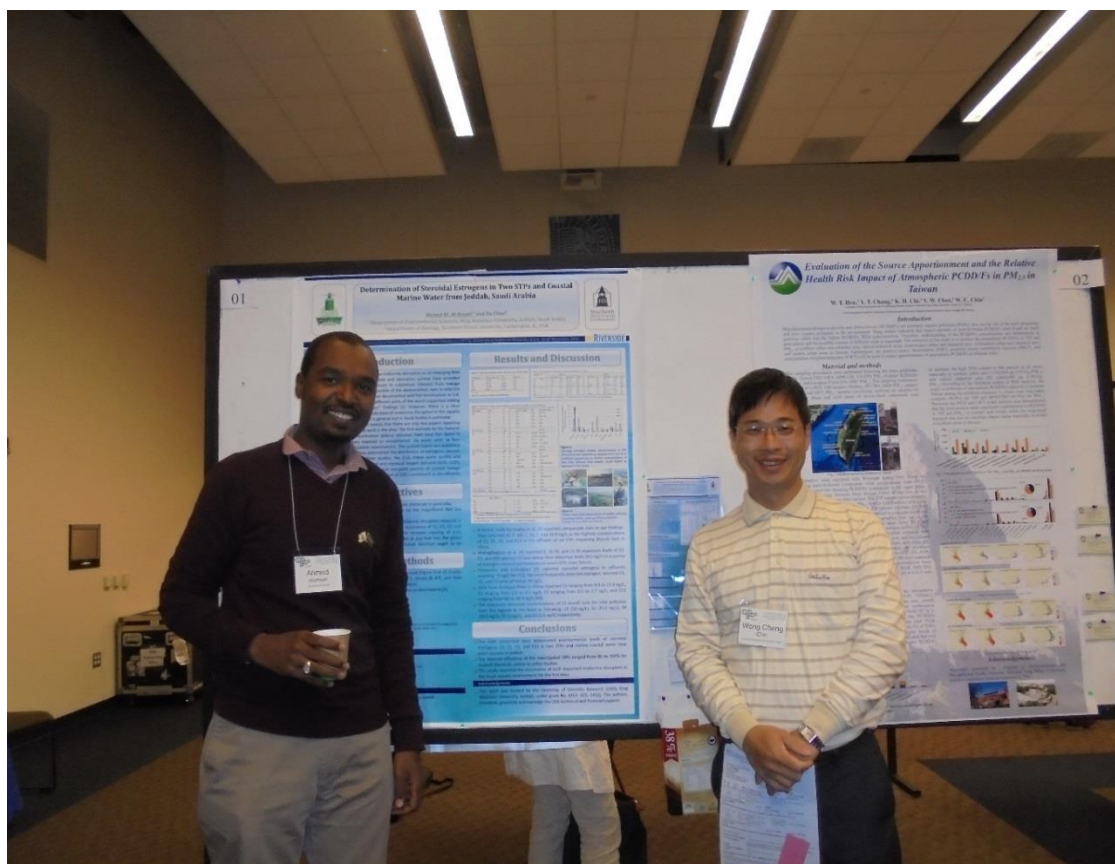


圖 23、與論文化者 Mi A. M. Al-Ansari (左)合影

肆、建議

- 一、推動持久性有機污染物管理以符合聯合國環境規劃署斯德哥爾摩公約管制趨勢為政府重要工作之一，建議對於 2015 年 5 月召開第 7 次締約方大會新增列管之 3 種物質，六氯丁二烯(Hexachlorobutadiene)、氯化萘(Chlorinated naphthalenes)及五氯酚(Pentachlorophenol)及其鹽、酯類持續關注其相關法規及檢測方法之訂定，以應用在國內環境調查之研究。
- 二、在此次大會有相當數量論文以阻燃劑(PBDEs)為主題發表，本所對此議題並不陌生甚至已有良好基礎，早在 2006 年即針對國內部分河川底泥、魚體及港灣底泥進行多溴二苯醚採樣檢測（李慈毅，2006），建議密切關注國際間對此等議題之探討及方法開發，有效應用在國內相關議題之研究。
- 三、本次大會論文分佈前 3 名分為環境流布類(67/266)其次是毒理探討類(59/266)，再者為分析方法探討類(51/266)，數量最少的是 PTS 焦點問題(17/266)。顯示環境流布類及毒理探討類議題已相當成熟。建議同仁可關注持久有機物焦點問題，此類議題較新，未來較易取得新成果，並應用在國內民生議題之研究。
- 四、第 13 屆(2016 年)國際持久性毒性物質研討會預定在德國漢堡舉行，期望本署及所內同仁有機會參與此會或其他類似會議(如國際含鹵持久性有機污染物)，發表論文及吸收先進經驗。

附件一 大會相片



大會場所-洛杉磯加州大學河濱分校 HIGHLANDER UNION BUILDING



大會報到處



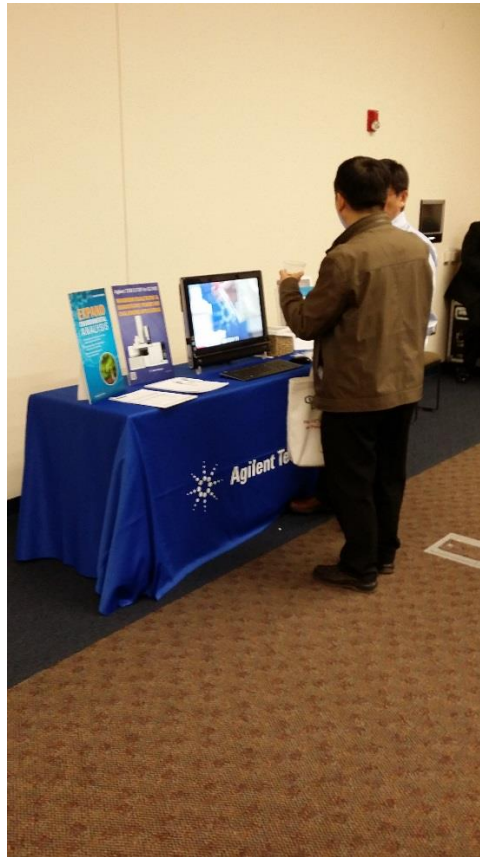
大會邀請 Duke University 教授 Heather M. Stapleton (Invited Speaker) 演講 "Flame retardant chemical applications in residential furniture and electronics: Linking sources to human exposure"



與會人員會議照



壁報展示處



大會參展儀器廠商

附件二 出國心得報告



出國心得進行業務簡報，與同仁進行知識分享

附件三 投稿論文摘要及壁報

The 12th International Symposium on Persistent Toxic Substance
16-20 November 2015, University of California, Riverside, CA

Evaluation of the Source Apportionment and the Relative Health Risk Impact of Atmospheric PCDD/Fs in PM_{2.5} in Taiwan

W. T. Hsu,¹ Y. T. Chang,¹ K. H. Chi,¹ Y. W. Chen,² W. C. Chin²

¹Institute of Environmental and Occupational Health Sciences, National Yang Ming University, Taipei 112, Taiwan; ²Environmental Analysis Laboratory EPA, Chungli 320, Taiwan.

Polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs) are persistent organic pollutants (POPs), they are the one of the most ubiquitous and toxic organic pollutants in the environment. Many studies indicated that largest amounts of particle-bound PCDD/Fs were found on small particles which had the higher PCDD/Fs TEQs concentrations. Therefore, understanding of the PCDD/F concentrations and distributions in atmosphere and the possible sources at different areas is important. The objective of this study is to monitor the atmospheric PCDD/Fs in TSP and PM_{2.5} at northern urban and suburban area, central industrial area, southwestern urban and industrial area, northeastern urban and industrial area, and eastern urban areas in Taiwan. Furthermore, the positive matrix factorization (PMF), potential source contribution function (PSCF), and concentration weighted trajectory (CWT) will be used in source apportionment of atmospheric PCDD/Fs at different areas.

Our study indicated that the highest concentration of the atmospheric PCDD/Fs observed at different regions were 56.8±9.65, 135±64.3, 26.9±7.47, and 48.3±19.6 fg I-TEQ/m³ at northern urban area, central industrial area (B), southwestern industrial area, and northeastern industrial area, respectively, and lowest concentrations (10.4±2.47 fg I-TEQ/m³) were observed at eastern urban areas. For the PCDD/F distribution in solid phase between TSP and PM_{2.5}, the total TEQs PCDD/Fs concentrations in PM_{2.5} were around 60.6% to 86.3% of TSPs, the results indicated that the PM_{2.5} contained with higher levels of PCDD/Fs than coarse particles. Our measurements also indicated that over 43.8% of PCDD/Fs were particle-bound in winter, and higher PCDD/F distribution in vapor phase in summer. In addition, the high TEQ content in fine particle at all areas, especially at northern urban area (1182±294 pg I-TEQ/g-PM_{2.5}) and central industrial area (B) (1063±488 pg I-TEQ/g-PM_{2.5}). According to the statistical results of PMF analysis, the major contributors of atmospheric PCDD/Fs observed in northern Taiwan during the northeast monsoon in winter were long-range transport (40.9%) for TSP and MSWI/IWI (45.9%) for PM_{2.5}. Moreover, the PSCF and CWT model analysis also demonstrated that the local sources made significant contributions to PCDD/Fs in TSP and PM_{2.5} in summer and winter, while the long-range transport was also an important impact factor especially in winter to northern areas in Taiwan.



Evaluation of the Source Apportionment and the Relative Health Risk Impact of Atmospheric PCDD/Fs in PM_{2.5} in Taiwan

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Introduction

Polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs) are persistent organic pollutants (POPs), they are the one of the most ubiquitous and toxic organic pollutants in the environment. Many studies indicated that largest amounts of particle-bound PCDD/Fs were found on small particles which had the higher PCDD/Fs TEQs concentrations. Therefore, understanding of the PCDD/Fs concentrations and distributions in atmosphere and the possible sources at different areas is important. The objective of this study is to monitor the atmospheric PCDD/Fs in TSP and PM_{2.5} at northern urban and suburban area, central industrial areas, southwestern urban and industrial area, northeastern urban and industrial area, and eastern urban areas in Taiwan. Furthermore, the positive matrix factorization (PMF), potential source contribution function (PSCF), and concentration weighted trajectory (CWT) will be used in source apportionment of atmospheric PCDD/Fs at different areas.

Material and methods

The sampling procedures were performed following the main guidelines of the Taiwan-EPA A809.11B, US-EPA PM_{2.5}-Federal Reference Method, and European Union EN-14907 PM_{2.5}. The sampling instruments consisted of a HVS TSP sampler (Shibata, HV-700), FRM PM_{2.5} sampler (PQ-200), and HVS PM_{2.5} sampler (Analytica). Ambient air samples for both vapor phase and solid phase of dioxin-like compounds were collected.

In addition, the high TEQ content in fine particle at all areas, especially at northern urban area (1182±294 pg I-TEQ/g-PM_{2.5}) and central industrial area (B) (1063±488 pg I-TEQ/g-PM_{2.5}). According to the statistical results of PMF analysis, the major contributors of atmospheric PCDD/Fs observed in northern Taiwan during the northeast monsoon in winter were long-range transport (40.9%) for TSP and MSWI/IWI (45.9%) for PM_{2.5}. Moreover, the PSCF and CWT model analysis also demonstrated that the local sources made significant contributions to PCDD/Fs in TSP and PM_{2.5} in summer and winter, while the long-range transport was also an important impact factor especially in winter to northern areas in Taiwan.

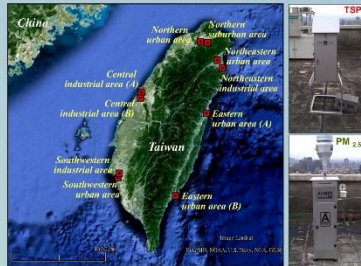


Fig. 1 Relative sampling locations in Taiwan

The samplers were equipped with Whatman quartz fiber filters for collecting particle-bound compounds while polyurethane foam (PUF) plugs were used for retaining PCDD/Fs compounds in the vapor phase. The main difference between these devices refers to the size of the particles that can reach the filter surface. The TSP sampler allows trapping the whole particulate, while in the PM_{2.5} system only particles with a size below 2.5 μm can be collected. The HVS TSP sampler (Shibata, HV-700) and HVS PM_{2.5} sampler (Analytica) was connected to a vacuum pump and 700 m³ of air mass was collected in 24 h at a sampling flow rate of 500 L/m³. The FRM PM_{2.5} sampler (PQ-200) were taken every 24 h and collected operating the instrument at an average ambient airflow of 16.7 L/m³. The PUF and filter samples were than Soxhlet extracted with toluene for 24 hrs, treated with concentrated sulfuric acid, and then passed through a series of clean-up columns containing sulfuric acid-silica gel, acidic aluminum oxide and celite/carbon. In this study, the seventeen 2,3,7,8-substituted PCDD/Fs congeners and 12 DL-PCBs (#77, #81, #105, #114, #118, #123, #126, #156, #157, #167, #169 and #189) were analyzed with high-resolution gas chromatography (HRGC)/high-resolution mass spectrometry (HRMS) (Waters AutoSpec-Ultima and JEOL JMS-700) equipped with a fused silica capillary column DB-5 MS (60 m x 0.25 mm x 0.25 μm, J&W).

Results and discussion

Our study indicated that the highest concentration of the atmospheric PCDD/Fs observed at different regions were 56.8±9.65, 135±64.3, 26.9±7.47, and 48.3±19.6 fg I-TEQ/m³ at northern urban area, central industrial area (B), southwestern industrial area, and northeastern industrial area, respectively, and lowest concentrations (10.4±2.47 fg I-TEQ/m³) were observed at eastern urban areas. For the PCDD/Fs distribution in solid phase between TSP and PM_{2.5}, the total TEQs PCDD/Fs concentrations in PM_{2.5} were around 60.6% to 86.3% of TSPs, the results indicated that the PM_{2.5} contained with higher levels of PCDD/Fs than coarse particles. Our measurements also indicated that over 43.8% of PCDD/Fs were particle-bound in winter, and higher PCDD/Fs distribution in vapor phase in summer.

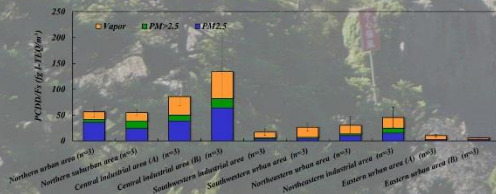


Fig. 2 Average PCDD/Fs concentrations in vapor phase and solid phase at different areas

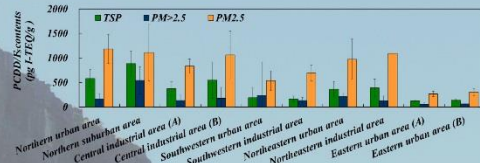
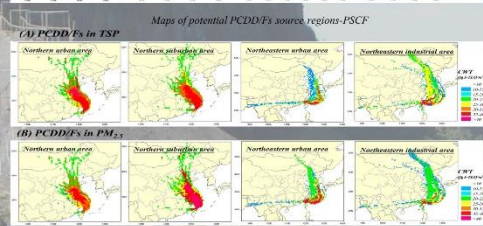
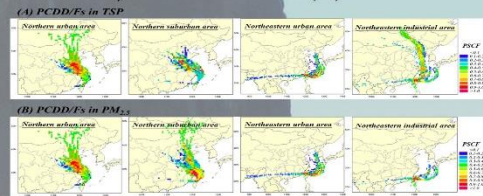
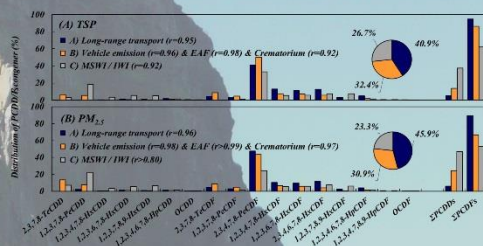


Fig. 3 The particle-bound PCDD/Fs in TSP, PM_{2.5} and PM_{2.5} at different sampling areas



Acknowledgements:

Assistance provided by Institute of Environmental and Occupational Health Sciences, National Yang Ming University and Environmental Analysis Laboratory EPA.



附件四 大會議程及資訊

大會議程：



Conference Agenda

Sunday, November 15

(Marriott Courtyard Hotel)

14:00-22:00

Registration

Monday, November 16

(Highlander Union Building)

8:00-12:00

Check-in & registration

8:30-8:45

Opening ceremony

8:45-12:10

Keynote and plenary session

12:10-13:30

Lunch break and poster viewing

13:30-17:00

Concurrent sessions

17:00-18:00

Poster session I

18:30-20:30

Reception (UCR Alumni & Visitor Center)

Tuesday, November 17

(Highlander Union Building)

8:30-10:15

Keynote and plenary session

10:15-10:30

Coffee break

10:30-12:05

Concurrent sessions

12:05-13:30

Lunch break and poster viewing

13:30-15:30

Concurrent sessions

15:30-16:00

Coffee break

16:00-17:00

Poster session II

17:00-18:15

Closing ceremony and young scientist awards

18:30-20:30

Symposium dinner (HUB)

Wednesday, November 18

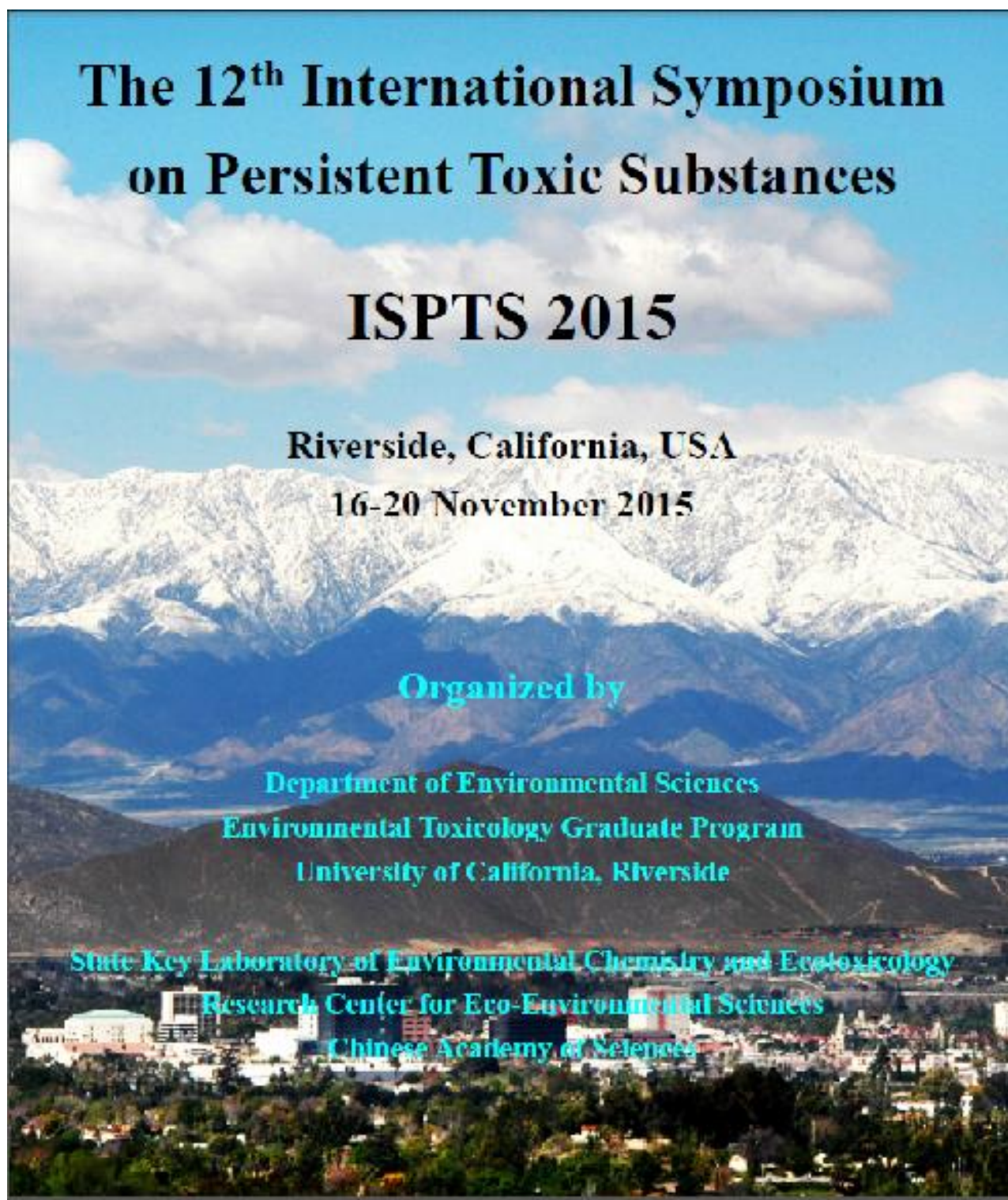
9:00 departure from Riverside

Field trip

Friday, November 20

16:00 return to Riverside

Field trip



**The 12th International Symposium on
Persistent Toxic Substances**

ISPTS 2015

**Riverside, California, USA
16-20 November 2015**

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