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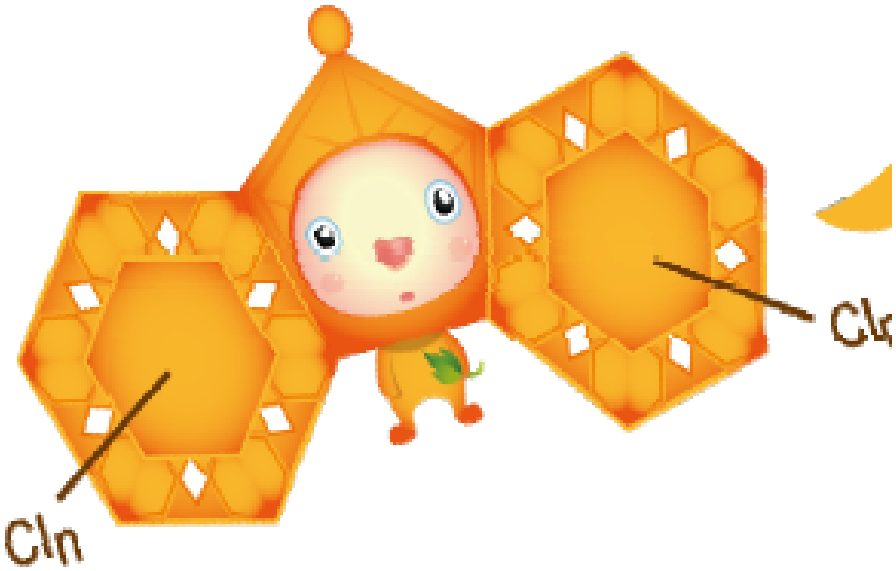
環境荷爾蒙及持久性有機汙染物研討會論文集

The 2016 Conference on Environmental Hormones and POPs



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第二十三屆太平洋科學大會(the 23rd Pacific Science Congress)

2016「環境荷爾蒙及持久性有機汙染物」研討會

Environmental Hormones and Persistent Organic Pollutants Forum

Contents

Inviting Speaker(s)

Oral Presentation

基於質譜的代謝組學對新持久性有機污染物的分子毒理研究

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摘要

許多持久性環境污染物具有類激素的性質，可以通過激素相關的受體干擾生物體的內分泌，破壞機體激素代謝的平衡。此外，部分污染物在某些酶作用下的代謝產物可以與蛋白質或者 DNA 形成複合物，造成分子的功能性損傷和人體身體健康問題以及多種疾病。

然而，持久性有機污染物在體內的含量比較低，受它影響的內源性物質的含量也是微量的，而且其分子毒理機制研究長期被忽視，有毒物質的複合健康效應研究也很少，有些新列入斯德哥爾摩公約的持久性有機污染物甚至還沒有可靠的毒理或毒性數據。本文闡述利用高靈敏度、高解析度的色譜-質譜聯用技術，建立代謝組學平臺對持久性有機污染物的毒理效應進行研究的重要性和可行性。

研究例子包括利用電噴霧電離技術檢測環境污染然物與 DNA 形成加合物從而造成 DNA 損傷；分析污染物與內源性激素與相關受體的競爭性結合；利用基於質譜技術的代謝組學檢測污染物（如 TCDD）作用後內源性代謝物的變化，從而推斷其毒理和毒性作用機理，並探索發現與重大疾病（肝癌、老年癡呆、糖尿病等）相關的小分子生物標誌物，研究環境污染物的分子毒理和毒性作用機理。

關鍵詞：

參考文獻：

[1] S. Lin, Z. Cai* et al, Int. J. Mass Spectrom. 301, 29-36 (2011).
[2] S. Lin, Z. Cai* et al, Mol Biosyst. 7, 1956-65 (2011).
[3] Y. Lai, Z. Cai*, et al, Environ. Sci. Technol. 45, 10720-27 (2011).
[4] X. Gao, Z. Cai*, et al, Anal. Chem. 84, 10236-10244 (2012).
[5] Analytical chemistry of persistent organic pollutants identified in the Stockholm Convention: A review, W. Xu, Z. Cai*, et al, Anal. Chim. Acta, 790, 1-13 (2013).

Implementation of Environmental Hormone Control Plan

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Abstract

In view of the environmental hormone substances may have adverse effects on human health, international attention to the issues of environmental hormones. Consumer protection committee instructed Environmental Protection Administration (EPA) to serve the convening unit of environmental hormone control plan. Thus EPA convene the relevant ministries to promote environmental hormone management plan through the inter-ministerial cooperation.

Through the organs of the division of responsibilities to promote the establishment of inter-ministerial group for goods, supplies, products, food and environmental sampling tests and background monitoring; confirm environmental hormone substances list species, evaluation the exposure risk of publics, promote environmental hormone management plan according to the division of responsibilities , strengthen propaganda of reduce the risk of prevention methods for publics.

Results: Collect information about the latest control measures for chemical substances and environmental hormones that have been adopted in other countries around the world, so as to provide a reference, and be able to submit recommendations regarding control measures in Taiwan and regarding the promotion of coordinated inter-agency management of environmental hormones. (2) Establishment the interministerial team; the member were: Environmental Protection Administration, Ministry of Economic Affairs, Ministry of Health and Welfare, Ministry of the Interior, Council of Agriculture and Ministry of Finance. (3) Confirm the type of environmental hormone substances. (4) Implementing of legislation and amendments. (5) Sampling tests and monitoring (6) Strengthening propaganda.

Due to the wide distribution of environmental hormones and media, it can not be regulate by a single act or a single authority. The environmental management plan hormones effectively and rapidly strengthening regulations, reducing exposure risk and ensuring the health of publics through ministries division of responsibilities. It will continue to strengthen cooperation and create the sustainable environment in the future.

Key words: *Environmental Hormone; Endocrine Disrupting Chemicals*

環境荷爾蒙管理計畫之推動

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摘要

鑑於環境荷爾蒙物質可能對人體產生不良健康影響，國際上對環境荷爾蒙議題日趨重視，行政院消費者保護委員會指示本署擔任我國環境荷爾蒙管理機制之召集單位，本署爰召集相關部會，透過跨部會合作與推動小組成員運作方式，共同推動環境荷爾蒙管理計畫。

透過各機關權責分工成立跨部會推動小組，針對商品、用品、產品、食品及環境等背景抽測監控；確認環境荷爾蒙之物質種類名單、對應民眾使用物品之種類及民眾暴露風險，依據各部會之權責分工推動環境荷爾蒙管理計畫，並針對民眾加強宣導及日常生活中之預防方法。

結果：(1)蒐集國際間化學物質及環境荷爾蒙物質之最新管制資訊供國內管理參考，據以提出國內管理建言及推動跨部會分工管理；(2)成立環境荷爾蒙管理計畫跨部會推動小組，成員包括：行政院環境保護署、經濟部、衛生福利部、內政部、行政院農業委員會及財政部；(3)確認環境荷爾蒙物質種類；(4)強化相關法規之執行及增修訂；(5)市場樣品抽測及監控；(6)加強民眾溝通及宣導。

由於環境荷爾蒙的分布與介質廣泛，無法以單一法令或單一機關來管制，因此環境荷爾蒙管理計畫透過各部會分工合作，有效且迅速進行環境荷爾蒙管理法規強化、減少環境荷爾蒙物質暴露、降低民眾風險及確保民眾健康，未來推動小組仍會持續加強合作，營造永續之生活環境。

關鍵詞：*環境荷爾蒙、內分泌干擾物質*

The willingness to pay for averting from the endocrine disrupting chemicals of the residents in Taiwan

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Abstract

Concern regarding the possible negative impacts of endocrine disrupting chemicals (EDCs), or environmental hormone, has been one of the major issues related to food safety in Taiwan these years. Contamination of some EDCs from the plastic containers or air-bone sources had been discussed since 1990's.

In 2010, a surprising scandal dug out by an government officials of FDA, about the long-term and widespread use of food cloudy agents contaminated by plasticizer in soft beverages, snacks, and other products triggered the attention and anger of the general public in Taiwan, as they found they have taken EDCs for a long period of time.

In this study, the understanding, attitude, and actions toward EDCs, and Persistent Organic Pollutants (POPs) of the general public in Taiwan were examined through conducting a survey, in which their willingness to pay (WTP) for averting from the EDCs were also collected and analyzed by employing the CVM.

It was found that people tend not to pay too much in these issues although the perceived risk is not low, as they though the government should be responsible for offering a safe environment for consumers. People with higher risk perception, and more active attitude and action intention tend to pay more if a EDCs free environment can be promised. Path analysis was also employed to demonstrate the direct and indirect impacts on the WTP of demographic variables and other intermediate variables including knowledge, attitude, action intention, and risk perception.

Key words: *EDCs; POPs; willingness to pay; perceived risk; understanding; attitude; action, path analysis*

臺灣民眾對環境荷爾蒙與持久性有機污染物之看法與願付價格研究

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摘要

近年來，關於內分泌干擾物質（環境荷爾蒙）可能帶來的負面效應已成為台灣社會與飲食安全相關的主要議題之一。自從 1990 年代以來，塑膠容器或空氣帶來的環境荷爾蒙污染持續受到各界的關切與討論。

2010 年，行政院衛生署食品藥物管理局的一位技術人員揭發了一個社會各界大為驚訝的醜聞。長時間以來，受到塑化劑污染的起雲劑廣泛使用在飲料、零食與其他產品中，臺灣民眾不僅趕到憤怒，且發現許多人都已經長期攝取了許多環境荷爾蒙。

本研究透過問卷調查，瞭解台灣民眾對於環境荷爾蒙與持久性有機污染物的理解、態度與行動。同時，透過條件評估法(CVM)蒐集與整理受測者願意為了避免環境荷爾蒙的污染付出的金錢價格(WTP)。

調查結果發現，雖然人們對於環境荷爾蒙的風險感知並不低，但為了避免環境荷爾蒙污染的願付價格並不高。民眾認為政府應該要提供消費者一個安全的環境。此外，風險感知較高、態度與行動傾向較積極的民眾願意為了避免環境荷爾蒙污染付出更多金錢。同時本研究透過路徑分析，探索人口學變項與若干中介變數，譬如知識、態度、行動、風險感知等，對願付價格的直接與間接效應。

關鍵詞：*內分泌干擾物質、持久性有機污染物、願付價格、風險感知、瞭解、態度、行動*

An overview of field and laboratory studies of environmental hormones and POPs on aquatic animals in Taiwan

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Abstract

The adverse effects of organic pollutants on organisms have been extensively documented for more than fifty years. In parallel, the safety of currently used chemicals with regard to their potential interaction with the endocrine system of organisms is also greatly concerned by the governments and the public all over the world.

Here, an overview of the contribution of studies with aquatic animals to understand the effects of environmental hormones and POPs at different levels of biological organization in Taiwan is presented. Examples of harmful effects on aquatic wildlife through gene expression, behavior, growth, development, reproduction or lethality are found in both freshwater and marine animals, e.g. oyster, snails, shrimps and fishes through field or laboratory studies. Basically, most of these studies relied on biomarkers such as vitellogenin induction, abnormality of reproductive system and detoxification enzymes.

There is no doubt that a great deal of research and efforts has been involved in past three decades in Taiwan. However, no convincing evidence of population-level relevant impacts of exposure to endocrine disruption chemicals (EDCs) in the wild exists and this is a common phenomenon everywhere. Since EDCs are ubiquitous in the environment especially in aquatic ecosystems, the regulation on its major source “wastewater” and the selection of locally appropriate endpoints/model organisms to document their effects are still the critical challenges which have to be faced in Taiwan.

Key words: *EDCs; biomarker; behavior; reproduction; environmental monitoring*

環境荷爾蒙及持久性有機汙染物對水生動物的影響－臺灣的野外及實驗室研究概觀

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摘要

全球性之研究指出有機污染物對生物有不良影響已超過半個世紀，而各種使用中的化學物質，其可能干擾生物內分泌系統的潛在風險，也長期受到各國政府和大眾的關注。

本報告概觀水生動物在探討環境荷爾蒙和持久性有機污染物對臺灣不同層次生物影響研究上的進展，藉由野外或室內實驗，這些化學物質對水生動物的影響呈現在基因表現、行為、成長、發育、生殖和致死效應上，如淡水或海洋性的牡蠣、螺類、蝦和魚類等，使用的生物指標有生殖系統變異、卵黃前質的誘發和解毒酵素表現異常等。

臺灣過去三十年在這些研究上雖然有些成果，但仍有很大的進展空間；例如，內分泌干擾物質造成螺類生殖構造異常，野外族群層級的影響卻沒有令人信服的數據，但我們並非唯一，全球多數地方也是如此。由於內分泌干擾物質普遍存在環境中，特別是水域環境系統，因此，其主要的源頭「廢汙水」管制和適合本地的測試物種、生物檢測指標之訂定，仍然是我們必須面對並亟需解決的嚴峻課題。

關鍵詞：*內分泌干擾物質、生物指標、行為、生殖、環境監測*

Causes of the skewed sex ratio in the Critically Endangered Formosa landlocked salmon (*Oncorhynchus formosanus*)

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Abstract

Formosa landlocked salmon (*Oncorhynchus formosanus*) survives as a remnant, landlocked population in the headwaters of the Chichiawan Stream, a tributary of the Tachia River of central Taiwan. Dams restrict the movement of fish in and out of the agricultural influenced zones. The residual estrogenic pollutant alkyl phenols, 4-nonylphenol (NP), 4-tert-octylphenol (OP), and the sex ratio of Formosa landlocked salmon were surveyed in the Formosa landlocked salmon ecological reservation area to evaluate the quality of habitat. Our hypothesis is that a relationship exists between the concentration of NP and OP in the stream environment and sexual determination in members of the resident Formosa salmon population.

157 fish were collected from 9 total habitat sites, and the amount of NP and OP present in each site (ambient water from rearing pools, streams, stream sediments, and agricultural effluents) was measured and fish sex was determined via a noninvasive, PCR-based method.

The results show significantly higher NP content and a skewed sex ratio in Formosa landlocked salmon found in agriculture zones compared to salmon found in non-agriculture zones. The concentrations and distributions of NP observed in this study are ecologically significant because they correspond with the skewed sexual ratio and the lower quality and quantity of male salmon sperm observed in previous field investigations.

Although the skewed sex ratios are likely a reflection of multiple endocrine disrupting compounds rather than simply NP and OP alone, these results support the contention that exposure of Formosa landlocked salmon to environmentally persistent estrogenic chemicals can result in deleterious reproductive consequences.

***Key words**: environmental hormone; fish; sex; Endangered; Taiwan*

造成極度瀕危臺灣陸封鮭魚雌雄性比偏差的原因

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摘要

臺灣鮭魚(*Oncorhynchus formosanus*)僅倖存且陸封於臺灣中部大甲溪上游的七家灣溪支流。防砂壩防止魚隻自由進出農業影響區域。我們調查臺灣鮭魚生態保育區的殘餘烷基酚雌激素污染物(壬基苯酚、辛基苯酚)、與臺灣鮭魚雌雄魚之性別比率，藉以評估棲地的品質。我們的假說：七家灣溪溪水中的壬基苯酚和辛基苯酚的濃度與殘存於其間的臺灣鮭魚之性別比率有相關。

我們在臺灣鮭魚生態保育區 9 個棲地共採集 157 尾臺灣鮭魚，我們測量每個棲地(養殖池池水、七家灣溪溪水、七家灣溪底土、農業排水)中的壬基苯酚和辛基苯酚的濃度；並以非侵入性的 PCR 方式推測並決定每尾臺灣鮭魚的雌雄性別。請參考 Hsu, T.-H. and Gwo, J.-C. 2010. SCI. A PCR-based method for sex identification of critically endangered Formosa landlocked salmon. Fisheries Sciences 76:613-618.

結果顯示七家灣溪位於農業影響區域的溪水中之壬基苯酚的濃度，比非農業影響區域溪水中之壬基苯酚的濃度，顯著的高；棲息於農業影響區域的臺灣鮭魚雌雄魚之性別比率也同樣顯著偏離 1:1。這結果具生態顯著性，因為和我們先前的田野調查發現：雄魚精液質與量低劣和壬基苯酚的濃度與分布位址有相關的結果相呼應。請參考 Huang, Y.S., Chen, M.-L., Chou, C.-C. and Gwo, J.-C. 2010. What inhibits the testicular development in Formosan landlocked salmon (*Oncorhynchus masou formosanus*)? In: Proceedings of the International Symposium on Formosa Landlocked Salmon and Masu Salmon, Juanes, F., Gwo, J.-C., Shieh, Y.T. (eds.), Journal of the National Taiwan Museum Special Publication No. 14:123-134.

雖然造成棲息於農業影響區域中的臺灣鮭魚雌雄性別比率偏差的原因，不是單靠壬基苯酚和辛基苯酚，而極可能是多重內分泌干擾物質的加乘或加成效果；我們的研究結果支持暴露臺灣鮭魚於持久性的類雌激素化學物質會造成有害其生殖的後果之論點。

關鍵詞：*環境荷爾蒙、魚、性、瀕危、臺灣*

Bi2Se3 Microplate Structures as NIR Light Induced Photocatalysts for degradation of organic pollutant dyes and Photothermal/ Photodynamic Inactivation of Bacteria

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Abstract

Organic pollutants and Bacterial infections are considered to be one of the major hurdles in the water purification (1, 2). Removal of organic dyes and inactivation of bacteria by using engineered nanomaterials in providing safe and clean drinking water is one of the very effective approaches.

To address the above mentioned problems, herein we report the synthesis and characterization of Bi2Se3 microplate structures for photothermal/photodynamic inactivation of bacteria as well as a robust photocatalyst operated in the near infra-red (NIR) region of the solar spectrum.

The as-synthesized Bi2Se3 microplates were systematically characterized using various spectroscopic and microscopic techniques. In addition, the Bi2Se3 microplates can also induce the generation of singlet oxygen upon 808 nm NIR light excitation.

Interestingly, the Bi2Se3 microplates did not exhibit noticeable cytotoxic effects in killing E.coli and s.aureus bacteria in dark and however, upon exposure of NIR (808 nm; 1 W/cm2) light, excellent photodynamic/photothermal killing efficiencies (~90%) as well as 95% degradation of organic dyes were achieved. Taken altogether, our results clearly pave a pathway in developing new nanostructures for water purification.

Keywords: *organic pollutants; photocatalyst; near infra-red light; bismuth selenide*

The molecular basis of transthyretin-related familiar amyloid polyneuropathy (TTR-FAP)

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Abstract

Among different mutated precursor proteins involved in familial amyloid polyneuropathy (FAP), transthyretin (TTR) related FAP (TTR-FAP) is the most prevalent and severe genetic subtype. For Taiwanese population, a unique Ala97Ser TTR mutation was found to account for 90% of Taiwanese patients with TTR-related Familial Amyloid Polyneuropathy (TTR-FAP). In this work, we designed experiments at protein level to assess the pathogenicity of Ala97Ser TTR. In addition, we performed measurements at protein level to assess the effect of tafamidis, a prescription drug for the treatment of TTR-FAP caused by Val30Met TTR. Our results have stimulated a clinical trial to exam the effect of tafamidis on the progression of TTR-FAP caused by Ala97Ser TTR.

Protein stability data was assessed with the associated melting temperature, measured by differential scanning calorimetry (DSC). Drug binding affinity was obtained using isothermal titration calorimetry (ITC) and nuclear magnetic resonance spectroscopy (NMR).

The melting temperature (Tm) of Ala97Ser TTR tetramer, 97.6°C, is lower than that of the wild type TTR tetramer, 101.3°C, which explains the reduced stability of the mutant. We also showed that the addition of tafamidis can increase the melting temperature to 101.5°C and 104.3°C for Ala97Ser TTR tetramer and the wild type TTR tetramer, respectively. ITC measurements show tafamidis binds to both the mutant (Kd1=5 nM, Kd2=208nM) and wild type TTR (Kd1=5nM, Kd2=158nM) at comparable affinities. The specific drug binding to both TTR proteins were confirmed with NMR experiments.

Our results suggest that Ala97Ser TTR is a pathogenic mutation, leading to the reduced stability of TTR tetramer. In addition, we show that tafamidis can stabilize the Ala97Ser TTR tetramer at protein level, which leads to an ongoing clinical trial to exam the drug effect of tafamidis on the disease progress.

Keywords: *Ala97Ser TTR; tafamidi, TTR tetramer stabilit; NMR*

Transthyretin (TTR)相關的家族性類澱粉沈積神經病變之分子基礎的研究

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摘要

位點突變的 Transthyretin (TTR)是家族性類澱粉沈積神經病變(familial amyloid polyneuropathy, FAP)中最常見的變異蛋白質。在臺灣，造成 TTR 相關的 FAP 患者中，有 90%的患者具有 Ala97Ser 位點突變，而且 Ala97Ser 位點突變的 TTR 所造成的 FAP 患者具有獨特的地域性(臺灣)。因此我們在蛋白質層次上,試驗 Ala97Ser 位點突變是否為致病原的突變。此外，我們也研究 Tafamidis 跟 Ala97Ser 位點突變的 TTR 的交互作用，了解 Tafamidis 這個已被用來治療 Val30Met TTR-FAP 之處方用藥,是否也能夠穩定 Ala97Ser 位點突變的 TTR 的四聚體結構。根據我們的結果，目前醫院正在進行 Tafamidis 於 Ala97Ser TTR 的 FAP 臨床試驗。

以示差掃描熱量分析儀(Differential scanning calorimetry, DSC)來測量蛋白質的熔點(melting temperature, Tm)，以評估蛋白質的穩定度。並以等溫滴定微量熱法(isothermal titration calorimetry ,ITC)和核磁共振光譜法(nuclear magnetic resonance spectroscopy, NMR)來分析藥物跟蛋白質之間的親和力。

四聚體結構的 Ala97Ser TTR 與四聚體結構的野生型(wild type) TTR 的熔點(Tm)，分別為 97.6°C 和 101.3°C，Ala97Ser TTR 的熔點(Tm)比 wild type TTR 低，顯示突變的 TTR 穩定度比較低。我們也顯示加 Tafamidis 的四聚體結構的 Ala97Ser TTR 與四聚體結構的 wild type TTR，其熔解溫度(Tm)，分別增加為 101.5°C 和 104.3°C。等溫滴定微量熱法實驗顯示 Tafamidis 結合 Ala97Ser TTR(Kd1=5 nM, Kd2=208 nM)的親和力與 wild type TTR(Kd1=5 nM, Kd2=158 nM)相似。藥跟兩種 TTR 的結合也以核磁共振光譜法來分析。

我們的結果建議 Ala97Ser 位點突變的 TTR，會導致四聚體結構的 TTR 穩定度降低，是家族性類澱粉沈積神經病變的致病原。我們在蛋白質層次的實驗上，顯示 Tafamidis 可以穩定四聚體結構的 A97S TTR。目前醫院正在進行之 Tafamidis 於 Ala97Ser TTR 的 FAP 臨床試驗，這個試驗結果將可以和蛋白質實驗的結果進行比較。

關鍵詞：Ala97Ser TTR、tafamidis、TTR 四聚體穩定度、核磁共振光譜法

Distribution and risk assessment of polycyclic aromatic hydrocarbons in the surface sediment from Danshui River, Taiwan

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Abstract

Spatial distribution and risk assessment of polycyclic aromatic hydrocarbons were investigated in 33 stations from surface sediments in the Danshui River, including Keelung River, Shindan Stream and Dahan Stream, Taiwan in 2015. The total 16 PAH level in the Danshui River sediment ranged from 26.4 to 1286.8 ng/g dry weight.

The principal components analysis and the molecular diagnostic ratios were show that the pyrogenic was main source of PAHs in the surface sediment from Danshiu River. The ecological risk assessment base on Screening-Level Ecological Risk Assessment indicated that the probability adverse biological effects to benthic organism are expected to occur in most stations, and thus PAH are considered as contaminants of concern in Danshui River.

Key words: *polycyclic aromatic hydrocarbon; Danshui River; sediment; risk assessment*

多環芳香烴化物於淡水河表層底泥中之分佈與危害評估

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摘要

本研究於 2015 年對淡水河(包括三條支流：基隆河、新店溪和大漢溪)共計 33 個測站進行底泥 PAH 濃度分佈和危害評估分析。總 PAH 濃度範圍為 26.4 至 1286.8 ng/g 乾重。

根據主成分分析和特徵化指數顯示淡水河底泥的 PAH 主要為燃燒性來源。使用美國環保署所開發之篩選層級生態風險評估（SLERA）進行淡水河底泥危害分析，結果顯示大部分測站的底泥呈現對水中低棲生物具危害性，因此仍須注意 PAH 污染物對淡水河水生生物的危害。

關鍵詞：*多環芳香烴，淡水河，底泥，危害評估*

Determination of Nitrite Endocrine Disruptor in Food with DIY Spectrophotometer

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Abstract

Food safety is a highly concerned livelihood issue. Addition of appropriate amount of nitrites as color retention agent during food processing such as bacon, sausage, and cured meat is common. It has also been used for preserving meat owing to its bacteriostat property. The International Agency for Research on Cancer (IARC) classifies nitrites as "probably carcinogenic to humans" (Group 2A). It is also regarded as endocrine disruptor in recent study. Herein, we assemble a portable spectrophotometer and simple operational procedures. It might assist citizens to carry out food safety testing in home, such as nitrites amounts in cooked vegetables and cured meat.

At first, utilize the simple spectrophotometer containing single slit, ocular lens and grating and also use the computers and analysis software. In normal, measuring nitrites usually take advantage of the reactions of nitrites and griess reagent that will change the color, and use the spectrophotometer to analyze.

After calibrating wave length and resolution analysis, when it measures the sodium D-lines of the salt emission spectrum, the resolution of the assembled spectrophotometer can go up to 6Å. The calibration curve's correlation coefficient R is 0.9936. Before we measure them, we need to remove the lipid and protein. The nitrites will coupling with the Griess reagent to prunosus azo compound. At 540nm of wave length, measure apparent absorbing light and read the absorbance can quantify the concentration of sodium nitrite.

The basic properties of homemade spectrophotometer are excellent and it can integrate Griess reagent to generate color reaction. The measurements of actual samples are keep proceeding. Compare and analyze the outcome of the conditions of cooking vegetables and the amounts of nitrites in the cured meat to figure out its advantages, disadvantages and its generalization.

Key words: *sodium nitrite; endocrine disruptor compounds; pickledmeat; spectrophotometer*

自製分光光譜儀檢測食品中內分泌干擾物亞硝酸鹽含量

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摘要

食品安全是近幾年來國人關注的重大民生議題，在食品加工過程中，可以合法添加適量亞硝酸鹽作為保色劑，但其抑菌功能，亦是其常用於醃肉、香腸、臘肉之原因。亞硝酸鹽急毒性較強一，可使正常的血紅蛋白變成高鐵血紅蛋白，失去載氧的功能，導致組織缺氧，且有致癌疑慮。亞硝酸鹽近年來亦被認為是內分泌干擾物。本研究組裝一套攜帶式的分光光譜儀，設計簡便的檢測程序，提供一般民眾方便作居家的食品安全檢測，如蔬菜在不同溫度烹煮條件及醃肉品中的亞硝酸鹽含量。

首先利用簡單的單狹縫、目鏡、光柵自製簡單的分光光譜儀，結合電腦及分析軟體。一般檢測亞硝酸鹽類常利用 Griess reagent 和亞硝酸根反應，產生顏色變化，再以分光光譜儀分析。

組裝完成的分光光譜儀，經校準波長、解析度分析等，檢測食鹽發射光譜中的鈉雙線，自製分光光譜儀的解析度達到 6Å。檢量線的相關係數 R2=0.9936，檢測前需先去除樣品中的脂質及蛋白質，亞硝酸根會和 Griess reagent 耦合成紫紅色的偶氮化合物，在波長 540 nm 處，觀測到明顯的吸收光，讀取吸光度，可定量亞硝酸鹽含量。

自製分光光譜儀的基本性質優良，結合 Griess reagent 產生呈色反應，實際樣品的檢測，持續進行中。將以檢測蔬菜在不同溫度烹煮條件及醃漬肉品的亞硝酸鹽含量，與市售分光光譜儀比較分析結果，探討其優缺點及推廣性。

關鍵字：*亞硝酸鹽、內分泌干擾物、醃漬肉類食品、分光光譜儀*

Toxicity Assessment of Phthalates using Zebrafish embryos and *Daphnia magna*

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Abstract

Phthalates are a class of worldwide manufacturing chemicals. They are present in many products from plastics, consumable products, to personal care products. Phthalates have been detected in many environmental matrices, wildlife animals, and human body. Phthalates are known endocrine disrupters and potential to cause adverse health effects. Herein, we are interested in understanding their toxicity effects on aqueous organisms using representative phthalates such as dibutyl phthalate(DBP) and benzyl butyl phthalate (BBP).

The adult zebrafish and *Daphnia magna* were cultivated in 20 L glass aquaria filled with 14 L treated tap water, which is continuously aerated using an air pump. The water temperature, pH, dissolved oxygen were measured daily at 14/10 hour of light/dark cycle. The *Daphnia magna* were tested for acute toxicity; whereas the Zebrafish embryos were tested for chronic toxicity. The healthy fertilized embryos were selected and cleavage stage embryos (＜3 hpf) were divided randomly into two study groups. Embryos were transferred to the wells of a 24 well plate containing solutions with known phthalate concentrations. The mortality, development, morphology, teratogenicity and, hatching rate were examined using light stereomicroscopy.

The toxicity of phthalates to *Daphnia magna* and zebrafish embryos was determined in this study. The 50% lethal concentrations (LC_{50}) were calculated based on their mortality-dose response curve. The LC_{50} of DBP and BBP to *Daphnia magna* is 3.7 mg/L and 1.76 mg/L, respectively; whereas they are 0.58 mg/L and 0.68 mg/L to For Zebrafish embryos. Both affected coagulated embryos and exhibited teratogenic effects.

Both DBP and BBP exhibited toxicity towards *Daphnia magna* and Zebrafish embryos. The LC_{50} found are similar to reported values. The adverse effects on Zebrafish embryos might inspire renew interest on their toxicity study.

Key words: *Phthalates; Daphnia magna; Zebrafish embryos; Toxicity*

鄰苯二甲酸酯對斑馬魚胚胎及水蚤的毒性評估

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摘要

鄰苯二甲酸酯是一種普遍製造的化學物質。它們存在於很多塑料產品中，如消費產品、個人護理產品等。鄰苯二甲酸酯存在很多環境介質中，可在野生動物和人體內被檢測到，是已知的內分泌干擾物，並可能造成不良的健康影響。因此，我們必須了解有關使用鄰苯二甲酸酯，如鄰苯二甲酸二丁酯（DBP）和苯鄰苯二甲酸丁酯（BBP）對水生生物體的毒性作用。

斑馬魚成魚和水蚤被養殖在 20 升玻璃水族箱中，內裝 14 升之馴養水，使用空氣幫浦維持水體含氧量。後續維持水溫、pH 值、溶氧及每日 14 小時光照週期。實驗以水蚤進行急性毒性試驗，以斑馬魚胚胎進行慢性毒性試驗，選擇介於胚胎發育期（<3 hpf）健康受精的胚胎，並區分為兩個研究組。將胚胎置於 24 微孔盤中，並加入不同濃度的鄰苯二甲酸酯溶液。利用倒置式光學顯微鏡進行死亡率、發育、形態、致畸和孵化率檢查。

本研究確認鄰苯二甲酸酯對大型蚤和斑馬魚胚胎的毒性。並利用統計程式及參考劑量－反應曲線計算出對大型蚤和斑馬魚胚胎的半數致死濃度值（LC_{50}%）。DBP 和 BBP 分別對大型蚤的 LC_{50} 值為 3.7 毫克/升和 1.76 毫克/升，對斑馬魚胚胎是 0.58 毫克/升和 0.68 毫克/升，並產生胚胎凝固及出現致畸作用之影響。

實驗過程發現 DBP 和 BBP 這兩種化學物質對大型蚤和斑馬魚的胚胎毒性與文獻資料之 LC_{50} 值相似，未來可繼續以斑馬魚胚胎進行相關類似苯二甲酸酯的毒性研究。

關鍵詞：*鄰苯二甲酸酯類、水蚤、斑馬魚胚胎、毒性*

Rapid determination of Bisphenol A in Thermal Papers by TOF-SIMS

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Abstract

Bisphenol A (BPA) is a well-known environmental hormone and commonly used as color developer in thermal paper (TP). TP was considered as a potentially important non-food source of BPA exposure. Herein, we report the studies of BPA in TP using time-of-flight secondary ion mass spectrometry (TOF-SIMS), aiming for BPA identification and determination in real sample.

Samples were collected from facsimile paper, calling/queuing card, automatic teller machine transaction list and receipt. BPA dissolving in stearamide that dropped at paper were used as standards for TOF-SIMS assay. For surface and depth profile assay of TP samples and the standards, a TOF-SIMS IV instrument with Bi_3^+ primary ions was performed. The BPA concentration of TP extract solutions were determined by HPLC-FLD as standard method.

The TP was readily analyzed by TOF-SIMS surface and depth profile. The former provides ion fragments of principal chemical species at thermal layer in TP such as BPA, leuco dyes and stearamide. The latter is useful to determine the distribution of various chemical species as a function of depth from the surface and thickness of respective layer. The calibration curve build up by as prepared standards and TOF-SIMS show an acceptable correlation coefficient value ($R^2 = 0.9477$). The BPA concentrations of TP surface determine by TOF-SIMS are from ND to c.a. 400 g kg^{-1}. Concentration of TP extract solutions are from ND to 50 mg kg^{-1} which regard as of bulky concentration of whole TP.

The surface analysis shows that direct and rapid identification of BPA and related compounds in TP is feasible. Signals of BPA were detected by TOF-SIMS surface analysis in mg L^{-1} level compare with determination by standard method. These results demonstrated that TOF-SIMS is a potential tool for screening BPA in TP and BPA-containing containers for food use. Research toward this end is currently ongoing.

Key words: *thermal paper; bisphenol A (BPA); Tof-SIMS, surface analysis*

以飛行時間式二次離子質譜儀快速檢測感熱紙中的雙酚 A

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摘要

感熱紙是一種具有多層結構的特用紙，其熱敏層中含有隱性染料及顯色劑等化合物，使得紙張可因受熱而改變顏色，不需再使用額外的油墨或碳粉。而雙酚 A（Bisphenol A）因價格低廉且呈色效果尚可，經常作為顯色劑而被用於市售之低價感熱紙產品中。因結構與雌激素相似，雙酚 A 已被視為一種內分泌干擾物，在部分國外研究甚至得出可能有致癌風險之結論。其攝入途徑除經由食物之外，亦被證實可經由感熱紙與手指的接觸而穿透皮膚進入人體。儘管經濟部標準檢驗局已於 100 年 1 月 10 日制定公布之中華民國國家標準 CNS15447「感熱紙」中，明確規範感熱紙中不可以含有雙酚 A，但在感熱紙中檢測到雙酚 A 的新聞卻時有耳聞。因此開發一種可快速鑑定感熱紙中是否含有雙酚 A 之分析技術確實有其必要性。

在本研究中，計有 7 件感熱紙樣品進行檢測，其來源包含叫號單、商店收據及傳真紙。以 Bi_3^+作為一次離子源之飛行時間式二次離子質譜儀被用於直接分析不同樣品之表面，並利用塗布在紙上的硬脂醯胺-雙酚 A 混和物作為固態標準品以建立檢量線及對熱敏層中雙酚 A 進行定量分析。高效液相層析-螢光光譜儀法則作為標準方法。表面及縱深分析結果顯示，共計 6 件偵測到雙酚 A 之特徵離子碎片，其分布之厚度約為 100 nm 左右。相關係數(0.948)證明由固態硬脂醯胺-雙酚 A 混和物與飛行時間式二次離子質譜儀所建立之檢量線是可作為熱敏層中雙酚 A 定量之用。定量結果顯示該 6 件樣品中熱敏層的雙酚 A 濃度介於 82,819-380,775 mg/kg。標準方法之定量結果則為 15-50 mg/kg。

飛行時間式二次離子質譜儀的應用可快速的鑑定熱敏層中的化學組成且有效區別雙酚 A 的存在與否，相對於標準方法的高效液相層析-螢光光譜儀分析，其可提供幾乎無樣品製備、無有毒溶劑使用及快速檢測等優點。

關鍵詞：*雙酚A、感熱紙、飛行式二次離子質譜儀、表面分析*