

肼与苯肼对斑马鱼胚胎和仔鱼的毒性研究*

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摘要 采用国际新推出的鱼类长效效应测定技术对水中肼与苯肼的毒性进行了测定。结果表明, 肼对鱼类具有很大毒性, 对斑马鱼胚胎发育有影响, 最低影响浓度 (LOEC) 为 0.049mg/L , 无影响浓度 (NOEC) 为 0.0245mg/L , 对仔鱼存活的最低影响浓度为 0.0035mg/L , 无影响浓度为 0.00175mg/L 。苯肼的毒性比肼大, 对斑马鱼鱼卵孵化的 LOEC 为 0.0078mg/L , NOEC 为 0.0039mg/L , 对仔鱼生存的 LOEC 为 0.00098mg/L , NOEC 为 0.00049mg/L 。结果表明, 仔鱼比鱼卵对肼及苯肼的毒性更敏感。笔者认为斑马鱼胚胎和仔鱼毒性实验方法是一个能反映毒物对鱼类长期毒性效应的快速实验技术值得推广使用。

关键词 肼, 苯肼, 毒性实验, 斑马鱼胚胎, 斑马鱼仔鱼。

肼 (Hydrazin) 是一种可贮存的高能火箭燃料, 已广泛用于战略战术导弹和人造卫星的运载火箭上, 以及工农业生产中, 如塑料、橡胶、染料。在使用及生产过程中可通过多种途径进入水体而造成污染。为此受到国内外的关注。Volre (1984) 曾报道了肼对脂头鲷鱼 (*Pimephales promelas*) 及蚤状溞 (*Daphnia pulex*) 的毒性实验。Slonim (1977) 曾用虹鱼 (*Lebistes reticulatus*) 做了硬水及软水中肼的毒性。Henderson 等 (1981) 用脂头鲷鱼做了肼对鱼胚胎的毒性及致畸作用。我国军科院做了肼、甲肼、偏二甲肼等对水生物的毒性实验。但国内外均未见到采用斑马鱼 (国际标准实验鱼) 的胚胎和仔鱼测试技术对肼及苯肼的毒性进行研究的报道。修瑞琴与 Goran Dave 合作研究了汞铜镍铅和钴对斑马鱼胚胎仔鱼的毒性 (1991), 在国际杂志上发表了研究论文。本文报道了采用斑马鱼做为实验动物对肼及苯肼毒性长效效应进行研究的实验结果。

一、材料和方法

肼与苯肼均为无色透明的液体, 具有氨样或鱼腥样臭味, 易溶于极性溶液中, 可与水互溶。实验用肼与苯肼由军事医科院提供, 实验

用鱼 (*Brachydanio rerio*) 购自北京, 在实验室内驯养 10 天以上。用特制鱼卵孵化装置进行人工受精而获得实验用鱼卵及早期仔鱼。实验方法参照欧洲标准实验法 (SIS, 1988) 及瑞典国家标准法。实验连续观察 10 到 16 天。在恒温光照培养箱中进行, 最终求出斑马鱼鱼卵孵化半数的时间 (MHT); 仔鱼半数致死时间 (MST); 鱼卵和仔鱼的最低影响浓度 (LOEC) 和无影响的最高浓度 (NOEC)。在对数纸上以实验浓度为横坐标, 以 MHT 及 MST 为纵坐标求出仔鱼生存影响曲线及鱼卵孵化影响曲线。

二、结果和讨论

1. 肼对斑马鱼胚胎及仔鱼的毒性

肼对斑马鱼胚胎及仔鱼的毒性实验结果见表 1、2 和图 1。结果表明肼能够抑制实验鱼胚胎的发育, 延长鱼卵孵化时间。由鱼卵半数孵化时间 (MHT) 及仔鱼半数存活时间 (MST) 所获得的曲线 (图 1) 可以看出, 仔鱼的 MST 随着浓度的增加明显减少。与对照组比较可以看

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出胙对鱼卵孵化的最低影响浓度 (LOEC) 为 0.049mg/L, 无影响浓度 (NOEC) 为 0.0245 mg/L. 胙对仔鱼的最低影响浓度 (LOEC) 为 0.0035mg/L, 无影响浓度 (NOEC) 为 0.00175 mg/L. 胙对斑马鱼的胚胎及仔鱼的安全浓度为 0.00175mg/L. SLonim (1977) 曾用虹鱼 (*Lebistes reticulatus*) 实验, 得到的安全浓度为 0.061mg/L, Henderson 等(1981)曾用脂头鲷鱼 (*Pimephales promelas*) 做了胙对鱼胚胎毒性及致畸影响, 得出对卵发育无影响的浓度为 1mg/L. 本实验结果表明, 胙对斑马鱼胚胎孵化的安全浓度为 0.0245mg/L, 对仔鱼安全浓度为 0.00175mg/L, 可见斑马鱼比虹鱼和脂头鲷鱼都敏感。

表 1 胙对斑马鱼胚胎及仔鱼的 MHT 及 MST 值

胙浓度 ($\mu\text{g/L}$)	MST(d)	MHT(d)
0	10	2.9
1.75	10	2.5
3.5	9.5	3.0
6.15	8.2	3.0
12.3	6.8	3.0
24.5	6.2	3.0
49.0	5.6	2.8
98.0	2.4	2.7
195.0	2.0	2.9

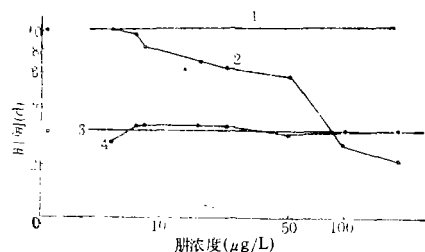


图 1 胙对斑马鱼胚胎及仔鱼毒性作用曲线

1. MST 对照 2. MST 3. MHT 对照 4. MHT

2. 苯胙对斑马鱼胚胎和仔鱼的毒性

苯胙对斑马鱼胚胎仔鱼的毒性实验结果表明其毒性很大 (图 2、表 2 和表 3), 由毒性作用曲线可以看出, 苯胙对斑马鱼仔鱼的半数存活时间 (MST) 随着浓度的增加明显降低。在 1.95mg/L 浓度时下降的更为明显。苯胙对胚胎具有抑制发育的作用。最低影响浓度为

表 2 胙与苯胙对斑马鱼胚胎及仔鱼的毒性实验结果 (mg/L)

指标	胙	苯胙
L-NOEC	0.00175	0.00049
L-LOEC	0.0035	0.00098
H-NOEC	0.0245	0.0039
H-LOEC	0.049	0.0078
SC	0.00175	0.00049

注: L-NOEC 仔鱼无影响浓度

L-LOEC 仔鱼最低影响浓度

H-NOEC 鱼卵无影响浓度

H-LOEC 影响鱼卵孵化最低浓度。

0.0078mg/L, 无影响浓度为 0.0039mg/L, 比胙的结果低 6 倍之多, 说明苯胙对斑马鱼胚胎的毒性比胙大。苯胙对仔鱼的最低影响浓度为 0.00098mg/L, 无影响浓度为 0.00049mg/L, 比胙对仔鱼的毒性大 3.5 倍。

从表 2 结果看出, 胙与苯胙对斑马鱼仔鱼的最低作用浓度 (LOEC) 和无影响浓度 (NOEC) 都低于对胚胎的 NOEC 和 LOEC 值, 说明斑马鱼的仔鱼比鱼卵对毒物更敏感。

表 3 苯胙对斑马鱼胚胎仔鱼的 MHT 和 MST 值

苯胙浓度 ($\mu\text{g/L}$)	MST	MHT
0 (对照)	13.6	2.2
0.49	13.3	1.95
0.98	13.0	1.50
1.95	12.2	2.2
3.90	11.2	2.3
7.80	5.6	2.3
15.6	1.4	—

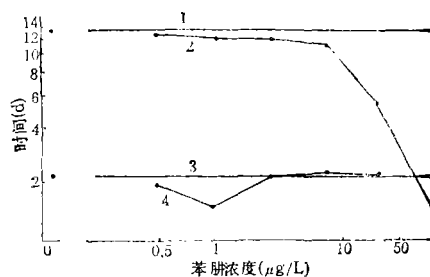


图 2 苯胙对斑马鱼胚胎和仔鱼的毒性作用曲线

1. MST 对照 2. MST 3. MHT 对照 4. MHT

三、结 论

1. 胙对斑马鱼胚胎及仔鱼有较大毒性, 对

胚胎的最低影响浓度(LOEC)为 0.0035mg/L, 无影响浓度(NOEC)为 0.00175mg/L, 仔鱼比鱼卵敏感。

2. 苯胂对斑马鱼胚胎及仔鱼有明显的毒性, 对胚胎的 LOEC 为 0.0078mg/L, NOEC 为 0.0039mg/L; 对仔鱼的 LOEC 为 0.00098mg/L, NOEC 为 0.00049mg/L, 仔鱼比鱼卵敏感。

3. 胂与苯胂对斑马鱼的安全浓度分别为 0.00175mg/L (胂)及 0.00049mg/L (苯胂), 苯胂明显比胂的毒性大。

4. 斑马鱼的胚胎和仔鱼对有毒化学品毒性

很敏感, 本方法是一个能反映毒物对鱼类长期毒性效应的快速实验技术, 值得推广使用。

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马尾松苗期体内铝离子存在方式、形态和分布*

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摘要 本文用溶液培养方法研究铝在马尾松幼苗体内的存在方式、形态及其分布。结果表明, ①松苗吸收的铝主要积累于根部, 只有少量的铝转移至地上部分; ②针叶内铝离子主要以束缚态的方式存在, 根内束缚态与自由态的存在比例大致相当; ③铝离子在表面自由空间大部分以三价铝离子的形态存在, 其中针叶内约占 63—85%, 根内占 41—67%; ④铝离子在根组织内的含量以外皮层为最高, 中柱最低, 呈现为从内向外增多的分布状态。

关键词 马尾松, 铝离子, 形态, 分布。

大量文献报道表明, 土壤酸化引起的铝毒可能是森林衰退的重要原因之一。为此, 国内外相继开展了铝对森林树种的影响研究, 并取得了不少重要结论^[1-4]。目前的工作主要集中在铝对树木生长发育的影响, 有关铝对树种毒害机理的研究却未曾见报道。笔者选择我国酸雨区的主要人工林, 也是我国酸雨区的主要死亡树种——马尾松为对象, 研究铝在松苗体内的存在形态、方式及其分布, 以初步确定铝对松种的毒害方式, 为下一步铝毒机理的进一步研究提供基础。同时通过对铝在松苗体内存在状况和分布的研究, 可进一步了解铝对马尾松的毒害程度和马尾松的抗铝性大小。

一、材 料 与 方 法

1. 材料

马尾松 (*Pinus massoniana* Lamb.), 种子来自广西柳州。

2. 松苗的培养

培养方法同文献[3], 铝处理浓度为 0、15、30、60、120 和 240 ppm 6 个梯度, 培养液 pH 为 3.5。

3. 铝含量测定

参照 $\text{HSu}^{[5]}$ 的方法, 在 50ml 的容量瓶中, 加入 1ml 铝溶液, 于 80℃ 的水浴中恒温, 30 分钟后停止, 待冷却至室温后, 加水稀释至 35ml, 加入 10ml 铝试剂缓冲液, 定容至 50ml, 混合后放置, 50 分钟后在 530nm 下测定其光吸收。

4. “自由态”与“束缚态”铝含量测定

植物体内存在的铝离子通常可分为两部分, 其中一部分存在于表面自由空间, 能通过离子交换的形式被代换出来, 这部分离子可称为“自由态”; 另一部分主要存在于细胞内, 不能以

* 国家“七五”科技攻关课题

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Abstracts

Chinese Journal of Environmental Science

Botany, Nanjing 210014): *Chin. J. Environ. Sci.*, **13**(6), 1992, pp.52—56

In this paper, the recent advance and achievement obtained in the study on effects of the enhanced UV radiation aroused by partial depletion of stratospheric ozone on plant growth responses, plant secondary chemistry and plant reproduction were synthetically reviewed.

Key words: Ultraviolet radiation (UV), ozone depletion, plant response to UV.

Analysis of the Cause of Filament Bulking in Activated Sludge and Controlling Methodology. Xu Xiaolu (Department of Geography Zhejiang Normal University Jinhua 321004), Shen Xiuying (Department of Biology Zhejiang Normal University): *Chin. J. Environ. Sci.*, **13**(6), 1992, pp.57—61

The paper intraduces some filamentous species which were isolated from sludge and identified recently, such as *Herpetosiphon*, *Bacillus mycoides*, *Eikelboom* types 021N, 1701, 0041 and 0803. Scum formation in activated sludge plants was associated with *Nocardia* of actinomycete family. Floc contained protein, carbohydrate, nucleic acids and ash. The setting ability of sludge improved with the increase of floc size and quantity and worsened by the increase of the total length of microorganism filament. The filament bulking can be eliminated by intermittent feeding, chlorine dosing, higher DO concentration and organic loading and adding initial compartment.

Key words: activated sludge, floc, Filament bacterium, Filament bulking.

Impacts of the Middle-line South to North Water Shifting Project to the Ecological Environment and Countermeasures. Jiang Chongyang (Tianmen Environmental Protection Bureau, Hubei 431700): *Chin. J. Environ. Sci.*, **13**(6), 1992, pp.61—63

This paper discusses the possibility that the implementation of the middle line south to north water shifting project may cause the dropping of water level decrease of water environmental capacity,

deterioration of water quality and increase of silting up in the middle and lower reaches of the Hanjiang River, leading to the shortage of agricultural irrigation water and the damage of part of the present irrigation system. The author suggested that shashi-shayang canal be built and the middle and lower reaches of Hanjiang River be comprehensively dredged during the implementation of the water shifting project.

Key words: water shifting project, impact to the environment, ecological balance, water conservation.

Studies on the Indicator of Human Exposure to Polynuclear Aromatic Hydrocarbons in Aluminum Plant. Zhao Zhenhua, Quan Wenyi, Tian Dehai (Beijing Municipal Research Institute of Environmental Protection, 100037): *Chin. J. Environ. Sci.*, **13**(6), 1992, pp.64—66

Levels of urinary 1-hydroxypyrene of the workers in an aluminum plant, pupils of the schools near the plant, and a control group were determined using high pressure liquid chromatography. Results show that the levels of urinary 1-hydroxypyrene of the workers of the aluminum plant were about 7.6 times higher than those of the pupils and about 43 times higher than those of the control group. The feasibility for using urinary 1-hydroxypyrene as indicator to assess human exposure to polynuclear aromatic hydrocarbons in aluminum plants is discussed in the paper.

Key words: 1-hydroxypyrene, polynuclear aromatic hydrocarbon, aluminum plant.

Toxicity of Hydrazine and Phenylhydrazine to Embryos and Larvae of Zebrafish (*Brachydanio rerio*). Xiu Ruiqin et al. (Institute of Environmental Health and Engineering, Chinese Academy of Preventive Medicine, Beijing 100050): *Chin. J. Environ. Sci.*, **13**(6), 1992, pp.67—69

The Toxicities of Hydrazine and phenylhydrazine to embryos and larvae of zebrafish, *Brachydanio rerio*, were studied under standardized conditions. Expo-

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tures to the chemicals started at the blastula stage and the effect on hatching and survival were monitored for 15 days. The results showed that toxicities of phenylhydrazin to both embryos and larvae were more than those of hydrazine. The LOEC (Lowest Observed Effect Concentration) for hatching was 0.049 mg/L for hydrazine and 0.0078mg/L for phenylhydrazin, the LOEC for survival of larvae was 0.0035mg/L for hydrazine and 0.00098mg/L for phenylhydrazin, respectively. The NOEC (No Observed Effect Concentration) for hatching was 0.0245mg/L for hydrazine and 0.0039mg/L for phenylhydrazin and the NOEC for survival of larvae was 0.00175mg/L for hydrazine and 0.00049 mg/L for phenylhydrazin, respectively. The safe concentration was 0.00175mg/L for hydrazine and 0.00049mg/L for phenylhydrazin.

Key words: toxicity, hydrazin, phenylhydrazin, *Brachydanio rerio*

Existing Pattern, Ionic Forms and Distribution of Aluminum in Masson Pine Seedlings. Gao Jixi, Gao Hongfa (Chinese Research Academy of Environmental Sciences, Beijing 100012): *Chin. J. Environ. Sci.*, **13** (6), 1992, pp.69—72

Using a hydroponic system, existing pattern, ionic forms and distribution of aluminum in masson pine seedlings were studied. Results show that: (1) Most of the aluminum absorbed by the pine seedlings accumulated in the roots and only a little of the aluminum was translocated to the shoots; (2) Majority of the aluminum in the shoots were bound, but there was only little difference in the amount of free and bound aluminum in the roots; (3) The dominant ionic form of aluminum in surface free space was Al^{3+} which accounted for about 63—85% of the total in the shoots and 41—67% in the roots; (4) In the roots, most of the aluminum existed in the epidermis of plant tissue and a little was found in the stele, showing an increasing tendency from the inside to the outside of plant tissues.

Key words: masson pine, aluminum, existing pattern, ionic forms, distribution.

Determination of Acetaldehyde in Waste Water by Chemiluminescence Method.

Lü Xiaohu, Lu Minggang (Department of Applied Chemistry, University of Science and Technology of China, Hefei 230026): *Chin. J. Environ. Sci.*, **13**(6), 1992, pp. 73—75
The chemiluminescence reaction of iso-propyl alcohol with $ClO^-H_2O_2$ is enhanced by acetaldehyde. This provides a novel chemiluminescence method for the determination of acetaldehyde. The linear range of the method is $5 \times 10^{-10}g/ml$ to $1 \times 10^{-6}g/ml$ with a detection limit of $8 \times 10^{-11}g/ml$. The effect of foreign substances was also studied. The method has been satisfactorily applied to the determination of acetaldehyde in waste water.

Key words: Iso-propyl alcohol, chemiluminescence, determination of acetaldehyde.

Concentrations and Distributions of Formaldehyde and Total Aldehyde in the Atmosphere of Beijing City in the Summer. Bai Yuhua et al. (Dept. of Technical Physics, Peking University, Beijing 100871): *Chin. J. Environ. Sci.*, **13**(6), 1992, pp.75—80

The concentrations of formaldehyde (HCHO) and total aldehyde (TCHO) in the ambient air of Beijing city in the summer of 1986 and 1987 were determined. Formaldehyde was analyzed with Nash method and total aldehyde was determined with MBTH method. Averaldehyde concentrations in the ambient air were 18.5 for 1986 and $9.9\mu g/m^3$ for 1987, respectively. The average formaldehyde concentration was $4.4\mu g/m^3$ for 1987, which accounted for around 50% of total aldehyde statistical analysis of the data from the two year's observation shows the effects of traffic automobile and reaction on the concentration of aldehyde. The results suggests that the appearance photochemical of aldehyde compounds in Beijing ampiant air was caused by both first and second pollutions.

Key words: formaldehyde, total aldehyde, atomospheric pollution, automobile pollution, photochemical reaction.

Determination of Furfural Content in

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