

草鱼在 2-硝基苄试验液中暴露后鳃组织结构变化的初步研究*

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摘要 用电镜观察的方法研究具有直接致突变性和潜在致癌性的化合物 2-硝基苄对草鱼鳃组织结构的影响。结果表明, 2-硝基苄对鳃组织有明显的损伤, 主要包括鳃小片的肿大和出现大量的泌氯细胞, 并在作用 10d 时观察到上皮细胞死亡。

关键词 2-硝基苄, 草鱼, 鳃, 毒性效应。

据文献报道, Lindane、DDT 等农药以及锌、铜、钙、溴化钠等无机物都能引起鱼的鳃和其它组织器官结构的变化^[1-2], 而损伤较严重的鳃组织的氧吸收功能大大减弱^[1,3]。

2-硝基苄(2-NF)是硝基多环芳烃的代表性化合物, 不仅具有直接致突变性, 还具有潜在致癌性^[4,5], 在许多环境样品中都检测到硝基多环芳烃的存在, 如大气飘尘、机车尾气、复印机用的碳黑、熏烤食品、湖泊底泥等等^[6-9]。草鱼和水生生物对 2-NF 有明显的富集效应^[10]。本文以草鱼为试验鱼, 用电子显微镜初步研究了 2-NF 作用后鳃组织结构的变化, 试图阐明 2-NF 对鳃组织的作用机理。

1 材料与方法

1.1 草鱼在 2-硝基苄试验液中的暴露

用 2-NF 的甲醇溶液配制 30L 试验液(0.124mg/L 2-NF, 甲醇<5mg/L), 从驯养水族箱中挑选 8 条生长正常、无疾病的草鱼(6-8g), 投入试验水族箱, 开始暴露试验。整个过程保持微通气状态, 温度在 18-20℃。每 1-2d 投饵料 1 次, 每天观察 1-2 次, 草鱼在 10d 的试验周期中在生活习性上没有观察到不正常的现象。

1.2 鱼鳃样品的制备

分别在暴露 2、4、10d 时取草鱼 1-2 条, 先

用蒸馏水冲洗体表, 滤纸擦干, 然后在解剖盘中小心剪断上、下鳃骨, 迅速取出鳃, 放到 2.5% 的戊二醛溶液中。

1.3 电镜样品的制备

鱼鳃用戊二醛固定液至少固定 2h, 再用 1% 的锇酸固定 2h, 丙酮脱水, Epon 树脂包埋, 在 60℃ 烘箱中聚合, 用 LKB-V 型切片机沿鳃小片纵向切片, 醋酸铀、柠檬酸铅染色后用 H-300 透射电镜观察。光镜切片用甲苯胺蓝染色。

2 结果

图 1、2 是对照鱼的鳃丝(gill filaments)的光镜和鳃小片(gill lamellae)的电镜观察结果。从横切面的光镜图看, 草鱼鳃的鳃小片象一些手指连接在鳃丝上。鳃小片的正常结构一般由上皮组织(epithelium)与柱状上皮细胞体系(pillar cell system)构成, 而柱状细胞体系包括柱状细胞(pillar cell)、边缘内皮细胞(marginal endothelial cell)、鳃小片基膜(lamellar basement)、鳃小片血腔(lamellar blood space), 血腔中有红血球。2-NF 作用 2d 后, 可见鳃小片

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尖端肿大,柱状细胞破裂(图 3、4),在尖端有泌氯细胞生成;作用 4d 后,鳃小片肿胀,有泌氯细胞出现,上皮细胞有许多突起,并形成许多非组织空腔,另外,有些鳃小片发生融合(图 5).在 10d 时上皮细胞膜失去它平坦的形状,有所突起,柱状细胞完全破裂,形成血腔(图 6);同时有些上皮细胞出现空泡,并有上皮细胞死亡(图 7).同时在上皮细胞中有电子致密物质出现(图 8).泌氯细胞数目增多,有些泌氯细胞的线粒体不象以前那样丰满,似不充实,发生变性.



图 1 对照鱼鳃鳃丝的光镜显微结构($\times 200$)

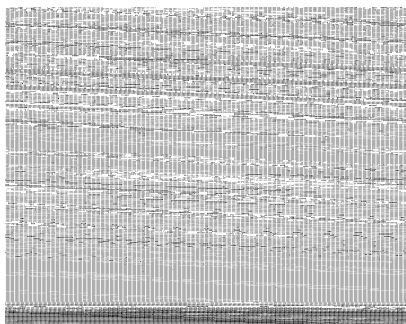


图 2 对照鱼鳃小片的电子显微结构($\times 3\ 000$)

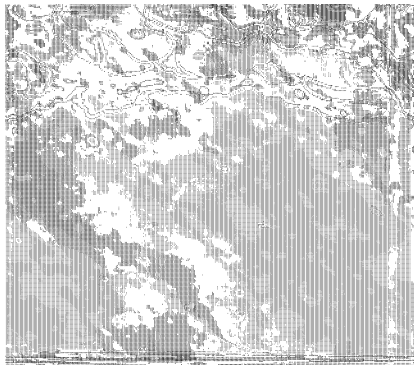


图 3 2-NF 作用 2d 后鳃小片的电子显微结构($\times 2\ 000$)

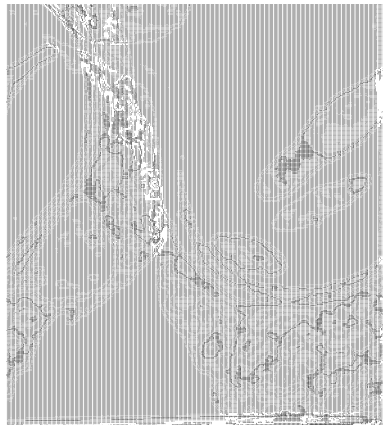


图 4 2-NF 作用 2d 后鳃小片的电子显微结构($\times 3\ 000$)

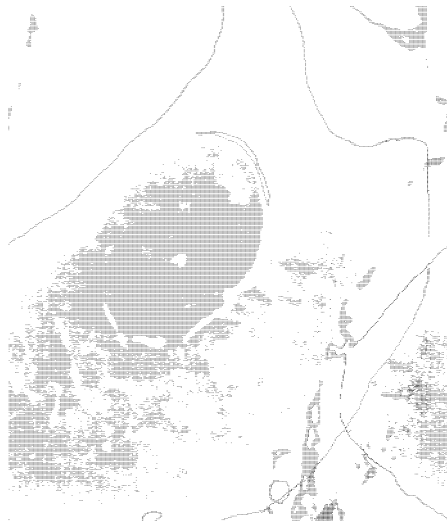


图 5 2-NF 作用 4d 后鳃小片的电子显微结构($\times 3\ 000$)



图 6 2-NF 作用 10d 后鳃小片的电子显微结构($\times 2\ 000$)

3 讨论

鳃小片是呼吸系统的重要组成部分,是与

外界进行气体交换的场所.2-NF 作用后最明显的变化是鳃组织的肿大,这与一些研究结果相似^[11].他们认为,肿大是接触污染物后的主

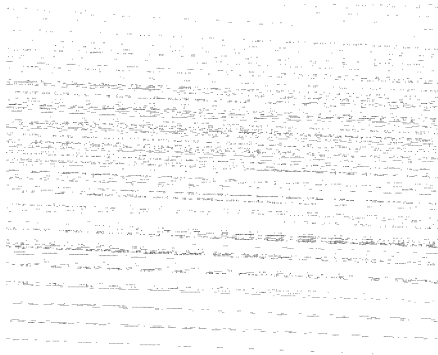


图 7 2-NF 作用 10d 后鳃小片的电子显微结构($\times 7\ 000$)



图 8 2-NF 作用 10d 后鳃小片的电子显微结构($\times 10\ 000$)

要反应。鳃小片的上皮组织一般是双层的,上皮细胞常常被一些胞间隙分隔开,这些胞间隙中含有粘液,在调节水-血通道上有重要作用,这种粘液空间由于空隙的肿大,产生被液体充满的非组织空间(non-tissue space),导致气体交换不能充分进行,并且影响扩散功能。损伤的上皮细胞和粘液细胞增多,这表明上皮细胞的寿命缩短。上皮细胞的血浆膜正常时是微小突起物状结构,这个结构可以增加功能上皮表面积,产生微湍,从而提高表面上皮上交换过程的效率。这种微小突起状物结构的减少和上皮细胞表面积的变化减弱了气体交换的能力。

在 2-NF 作用后另一较明显的变化是鳃小片上产生一些泌氯细胞,鳃小片上出现大量的泌氯细胞只有在进行实验、急性中毒、重金属污染和环境变化时才观察到。即鳃小片泌氯细胞的增加是对环境变化的一个反应。泌氯细胞的一个特点是有浓密的线粒体,典型泌氯细胞是大量的颗粒状的内质网,泌氯细胞的结构、功能已经有了一些研究^[12]。许多研究者认为,泌氯

细胞在鱼的调节渗透的机理中起着一定的作用。在 2-NF 作用 10d 时,泌氯细胞受到较明显的损伤,线粒体变性,这在鳃的其它毒性试验中很少见到。线粒体是对中毒和渗透调节比较敏感的细胞器,它的损坏可能影响泌氯细胞的功能,也抑制了 Na, K-ATP 酶和氧化磷酸化等能量过程中的酶。

本文研究内容表明,可以利用形态学来研究污染物对鱼鳃组织的损伤。这种方法也可以用来研究其他污染物,以及污染物作用后肝、肾等组织的超显微结构变化。如果要全面了解鱼鳃对 2-NF 的非特异性反应,还必须进行生物化学、组织学和生理学的研究。

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The Effect of 2-Nitrofluorene Exposure on Gill Structure of the Grass Carp. Yu Gang and Xu Xiaobai (Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, Beijing 100085): *Chin. J. Environ. Sci.*, **18**(1), 1997, pp. 1-3

Nitrated polycyclic aromatic hydrocarbons are a class of important pollutants with direct-acting mutagenicities and carcinogenicities. 2-nitrofluorene is a representative compound of nitro-PAHs. This paper reported the effect of 2-nitrofluorene exposure on gill structure of the grass carp. After 2, 4, 10 days of exposure, gill of fish was examined under electron microscope. The most severe gill lesions included the hypertrophy and increased number of chloride cells. This type of structure damage shows a dose similarity to those caused by other pollutants, such as lindan.

Key words: 2-nitrofluorene, grass carp, gill, toxic effect.

The Blown Sand Disaster Along Tarim Desert Oil-Transportation Highway. Dong Zhibao, Chen Guangting et al. (Institute of Desert Research, Chinese Academy of Sciences, Lanzhou 730000): *Chin. J. Environ. Sci.*, **18**(1), 1997, pp. 4-9

By means of field observation and laboratory experiment, the generation of the blown sand disaster along Tarim desert oil-transportation highway was analysed, the extent assessment model was established. Finally the conclusions reached are: (1) In the temporal distribution, the disaster is mainly concentrated on spring and summer (April-September), the most severe is in April. (2) In the spatial distribution, the disaster is more intensive into the desert. (3) Extent zones are outlined according to the theoretically estimated values of blown sand disaster extent, which fit well in the blown sand disaster phenomena observed and recorded.

Key words: blown sand disaster, tempo-spatial distribution, Tarim desert oil-transportation highway.

Study on Degradation of Phenolic Compounds by *Candida maltosa*. Yin Ping, Yang Yanxi and Yang Huifang (Institute of Microbiology, Chinese Academy of Sciences, Beijing 100080): *Chin. J. Environ. Sci.*, **18**(1), 1997, pp. 10-13

Degradation of 15 kinds of phenolic compounds by *Candida maltosa* 10-4 was studied. This yeast can utilize dihydric phenol and trihydric phenol as sole carbon source for growth. Three kinds of dihydric phenol (300 mg/L) can be degraded 97%-99% in 48 hours. Nitrophenol, aminophenol and cresol can not be used as sole carbon source, but nitrophenol and aminophenol can be used as nitrogen source for growth. With glucose as carbon source and $(\text{NH}_3)_2\text{SO}_4$ as nitrogen source, the growth and degradation activity can be

promoted obviously. Removal of mononitrophenol (300 mg/L) can reach 93%-100%, 2-or 4-cresol 86% and monoaminophenol 68%-84%. With substituting groups increase, degradation of phenolic compounds become slower. Cells adapted by 1200 mg/L of phenol can oxidate high concentration (2800 mg/L) of phenol and 15 kinds of phenolic compounds (300 mg/L) to different degree.

Key words: phenolic compound, *Candida maltosa*, degradation.

Nitrogen Content Dynamic Variation Analysis in the Second Songhua River. Liu Jingshuang, Yu Junbao et al. (Changchun Institute of Geography, Chinese Academy of Sciences, Changchun 130021): *Chin. J. Environ. Sci.*, **18**(1), 1997, pp. 14-16

Space-time variation law of nitrogen content in different river sections, water periods and years in the second Songhua River were described in detail. The results showed that there are direct relation between nitrogen content variation in water and nitrogen in waste water to come from cities and runoff water of both banks of the river. Nitrate and nitrite contents in water in flood period are higher than that of mid and low water periods. In flood period, nitrate content in water increases gradually with extension of river section, ammonia content in polluted river section is higher than that of unpolluted river section. Nitrate and nitrite contents in water in three water periods from 1985 to 1989 are slightly higher than that from 1980 to 1984 and from 1990 to 1994, ammonia content in water increased annually.

Key words: nitrogen content, space-time variation law, the Second Songhua River.

A Research on Technology for Recovery Resource from High Concentration J-Acid Waste Liquors. Li Zhonghe, Zhu Wanpeng et al. (Dept. of Environ. Eng., Tsinghua University, Beijing 100084): *Chin. J. Environ. Sci.*, **18**(1), 1997, pp. 17-19

J-acid waste liquors is a high concentration organic waste water. In this research N_{235} was used as extractant to extract useful substance from the J-acid waste liquors. The tests indicated that more than 95% of COD_Cr in J-acid waste liquor can be removed and COD_Cr in the remained liquors can be dropped to 500-2000 mg/L. 95% of colourity can be removed from the waste liquors. By back-extraction tests, extracted organic from waste liquors can be concentrated 5 to 10 times. In the process the extractant could be recycled for that its properties don't vary and it's lost is little. By recovery tests, the concentrated solution could be back to the appropriate section of the producing process directly to recovery useful substance, which will have no detrimental effects on the comprehensive in-