

中度以上损伤分别仅占 3.3% 和 4.7%，未见重度以上损伤。由此可见，30  $\mu\text{mol/L}$  及以上浓度 MX 均可引起 HepG2 明显的 DNA 损伤，中度和重度以上损伤百分比均随着 MX 浓度的增加而逐渐增加，揭示了 MX 的遗传毒性作用以及对人类健康的潜在危害性。

Holme<sup>[15]</sup>等曾以 MX (0~300  $\mu\text{mol/L}$ ) 处理 HL-60、人外周血单核细胞，结果显示 MX 在 100  $\mu\text{mol/L}$  及以上，碱滤洗脱法可检测到 DNA 单链断裂水平增加。本次彗星试验结果表明 30  $\mu\text{mol/L}$  及以上浓度的 MX 可引起 HepG2 明显的 DNA 链断裂，与其结论相一致，而且表现更为敏感，说明彗星试验在评价氯化消毒副产物的遗传毒性方面是一个非常灵敏的指标。

#### 参考文献:

- [1] Kronberg L, Vartiainen T. Ames mutagenicity and concentration of the strong mutagen 3-chloro-4-(dichloromethyl)-5-hydroxy-2(5H)-furanone and of its geometric isomer E-2-chloro-3-(dichloromethyl)-4-oxo-butenoic acid in chlorine-treated tap water[J]. *Mutat Res*, 1988, 206: 177-182.
- [2] Jansson K, Mäki-Paakkanen J, Vaitinen SL, et al. Cytogenetic effects of 3-chloro-4-(dichloromethyl)-5-hydroxy-2[5H]-furanone(MX) in rat peripheral lymphocytes in vitro and in vivo[J]. *Mutat Res*, 1993, 299: 25-28.
- [3] Mäki-Paakkanen J, Jansson K, Vartiainen T. Induction of mutation, sister-chromatid exchanges, and chromosome aberrations by 3-chloro-4-(dichloromethyl)-5-hydroxy-2[5H]-furanone in Chinese hamster ovary cells [J]. *Mutat Res*, 1994, 310: 117-123.
- [4] Brunborg G, Holme JA, Soderlund EJ, et al. Genotoxic effects of the drinking water mutagens 3-chloro-4-(dichloromethyl)-5-hydroxy-2[5H]-furanone(MX) in mammalian cells in vitro and in rats in vivo[J]. *Mutat Res*, 1991, 260: 55-64.
- [5] Furihata C, Yamashita M, Kinai N, et al. Genotoxicity and cell prolifer-

- ative activity of 3-chloro-4-(dichloromethyl)-5-hydroxy-2[5H]-furanone (MX) in rat glandular stomach[J]. *Water Sci Technol*, 1992, 25: 341-345.
- [6] Singh NP, Stephens RE, Schneider EL. Technical reports: modification of alkaline microgel electrophoresis for sensitive detection of DNA damage[J]. *Int J Radiat Biol*, 1994, 66: 23-28.
  - [7] Koivusalo M, Vartiainen T, Hakulinen T, et al. Drinking water mutagenicity and leukemia, lymphomas, and cancers of the liver, pancreas, and soft tissue[J]. *Arch Environ Health*, 1995, 50: 269-276.
  - [8] Holmbom B, Ronald HV, Richard DM, et al. Fractionation, isolation and chlorination of Ames mutagenic compounds in kraft chlorination effluents[J]. *Environ Sci Technol*, 1984, 18: 333-337.
  - [9] Hemming J, Holmbom B, Reunanen M, et al. Determination of the strong mutagen 3-chloro-4-(dichloromethyl)-5-hydroxy-2 [5H]-furanone in chlorinated drinking and humic waters [J]. *Chemosphere*, 1986, 15, 549-556.
  - [10] Meier JR, Knohl RB, Coleman WE, et al. Studies on the potent bacterial mutagen, MX: aqueous stability, XAD recovery and analytical determination in drinking water and in chlorinated humic acid solutions [J]. *Mutat Res*, 1987, 189: 363-373.
  - [11] Suzuki N, Nakanishi J. The determination of strong mutagen, MX in drinking water in Japan [J]. *Chemosphere*, 1990, 21: 387-392.
  - [12] Zou Huixian, Xu Xu, Zhang Jinqi, et al. The determination of strong mutagen MX [3-chloro-4-(dichloromethyl)-5-hydroxy-2(5H)-furanone] in drinking water in China [J]. *Chemosphere* 1995, 30: 2219-2225.
  - [13] Sasaki Yu F, Nishidate E, Izumiyama F, et al. Detection of in vivo genotoxicity of 3-chloro-4-(dichloromethyl)-5-hydroxy-2[5H]-furanone(MX) by the alkaline single cell gel electrophoresis(Comet) assay in multiple mouse organs[J]. *Mutat Res*, 1997, 393: 47-53.
  - [14] 甘起霓. HepG2 在体外遗传毒理学中的应用[J]. *国外医学卫生学分册*, 2000, 27(5): 293-295.
  - [15] Holme JA, Haddeland U, Haug K, et al. DNA damage induced by 3-chloro-4-(dichloromethyl)-5-hydroxy-2 [5H]-furanone (MX) in mammalian cells in vitro and in mice [J]. *Mutat Res* 1999, 441: 145-153.

(收稿日期: 2003-01-28)

(本文编辑: 李国玲)

## 【 监督监测 】

文章编号: 1001-5914(2003)06-0328-01

# 海拉尔地区游泳池水质余氯调查

刘宝霞, 王金英, 敖海英, 陈玫

关键词: 公共设施; 消毒; 卫生调查; 游泳池 中图分类号: R126.4 文献标识码: E

我站于 2000~2002 年依据《公共场所卫生管理条例》对海拉尔地区 3 家游泳池水的余氯情况进行了监测。检验方法按 GB5750-1985 中的方法(邻联甲苯胺比色法)操作, 检验结果依据 GB9667-1996《游泳场所卫生标准》进行评价: 在被检测的水样中, 游离性余氯的含量高于和低于标准值均判为不合格样本。共检测水样 154 件, 合格率见表 1。2000~2002 年间, 游离性余氯高于标准值的水样所占的比率逐年升高, 分别为 7.89%, 40.0%, 63.64%。经检验, 差异有显著性( $\chi^2=26.77, P<0.005$ ), 而游离性余氯低于标准值的水样却逐年降低(92%, 60%, 36%)。

本地区游泳池水多用含氯消毒剂进行消毒。由于从业单位普遍对消毒认识不足及消毒方法落后, 管理松散, 导致本地区游泳池水余氯含量的合格率低。近年来, 由于我站监测力度加大, 游泳池加氯量有所增加, 但又使得余氯含量高于标准值的比例

作者单位: 呼伦贝尔市海拉尔区卫生防疫站(内蒙古 呼伦贝尔 021000)

表 1 2000~2002 年游泳池水游离余氯合格率

采样时间(年)	水样数(件)	合格数(件)	合格率(%)
2000	44	6	13.64
2001	58	3	5.17
2002	52	8	15.38
合计	154	17	88.96

逐年上升, 合格率却没有变化。余氯含量过高, 既浪费药剂, 又使得池水的感官指标下降, 对皮肤和粘膜的刺激加大, 这再次反映了从业单位对消毒的错误认识。因此, 应加强对游泳馆从业人员消毒知识的培训, 加强从业单位的消毒管理, 改进消毒方法, 为广大消费者营造一个安全合格的卫生环境。

(收稿日期: 2003-05-20 修回日期: 2003-07-15)

(本文编辑: 李国玲)