Effects of Bisphenol A on Dams during Lactation Period in Rats

Pan Gyi Kim* · **Jae-Hong Leu[1]** · **Hee Joo Kang** · **Jeong Hyun Kim**

Division of Environmental and Biological Sciences, Yongin University, Yongin 449-714, Korea
[1]Institute of Natural Science, Yongin University, Yongin 449-714, Korea

Abstract

Bisphenol A (4,4'-isopropylidenediphenol, $C_{15}H_{16}O_2$) is the monomer used in the manufacture of polycarbonate. Polycarbonate, in turn, is used in a wide array of plastic products, with new applications continuously being developed. Also it has been used to produce epoxy resins and polycarbonate plastics for food container. This study was carried out to investigate the effects of bisphenol A on lactation period to dams and F1. Sprague-Dawley females were mated with on 2:1 ratio basis. Various doses of bisphenol A (0, 2, 20, 200, and 2,000 μg/kg) were daily administered to females for 21 days after parturition. Dams and offsprings were sacrificed at the time of weaning. The results were as follows, 2000 μg/kg of bisphenol A decreased the dams' body weight at post-partum 18 days and also 200 and 2000 μg/kg of bisphenol A decreased the body weight of neonates at the days of post-partum 21 days. Bisphenol A increased the relative weights of liver and spleen in male offsprings, depending on the doses. But female offsprings showed high relative organ weights of ovaries, and low relative organ weights of uterine in a some dose-response manners. High dose of bisphenol A induced low viability of neonates exposed during lactation period. The dams treated with bisphenol A showed prematured estrous stage. Bisphenol A was recovered about 21.2% average in serum of dams, and also in offsprings'. The results indicate that the bisphenol A induces estrous cycle during lactation period in dams, also reaches to the offspring through breast milk. Thus bisphenol A exopsed to dams and neonates via lactation induces some estrogenic and toxic effects.

Key words : bisphenol A, lactation, food container, endocrine disruptor

Table 1. Reproductive performance of dams and viability of neonates administered orally with bisphenol A during lactational period [mean(number)±SD]

Group (μg/kg)	control	2	20	200	2000
No. of implantation	12.4±3.80	13.2±3.74	13.8±4.83	12.8±4.10	14.1±4.71
No. of live fetus	11.5±4.30	12.1±4.36	13.1±5.34	12.1±4.50	13.3±4.97
Pregnancy rate(%)	(92.7)	(91.7)	(94.9)	(94.5)	(93.6)
M/F ratio	0.94	0.89	0.93	0.98	0.94
4 days viability (%)	90/92 (98)	106/109 (97)	89/92 (97)	93/97 (96)	101/106 (95)
21 days viability (%)	63/64 (98)	70/72 (97)	54/56 (96)	61/64 (95)	61/64 (95)

* : statistically different from control group ($p<0.05$)

Table 2. Estrous cycle of dams before autopsy

Group(μ g/kg)	Proestrus	Estrus	Diestrus	Total
Control	-	-	8	8
2	-	-	9	9
20	-	-	7	7
200	1	2	5	8
2,000	-	2	6	8

Table 3. Concentration of bisphenol A in serum of dams and neonates

Group (μ g/kg)		Control	2	20	200	2,000
Neonates (μ g/ml)	male	-	0.88±0.017	1.86±0.013	2.14±0.013	2.22±0.013
	female	-	0.93±0.021	1.94±0.013	2.29±0.013	3.50±0.013
Dams (μ g/ml)			1.71±0.013	1.99±0.108	2..88±0.244	3.59±2.705

- : Not detected

Atkinson A and D Roy. 1995. In vivo DNA adduct formation by bisphenol A. Environ. Mol. Mutag. 26:60-66.

Andersen ME, HJ Clewell III, J Gearhart, BC Allen and HA Barton. 1997. Pharmacodynamic model of the rat estrus cycle in relation to endocrine disruptor. Toxicol. Environ. Health 52:189-203.

Bortons JA, MF Lea-Serrano, M Villalobos, V Pedraz and N Olea. 1995. Xenoestrogens released from lacquer coating in food cans. Environ. Health Perspect. 103:608-612.

Jobling S, T Reynolds, R White, MG Parker and JP Sumpter. 1995. A variety of environmentally persistent chemicals, including some phthalate plasticizers, are weakly estrogenic. 103:582-587.

Krishnan AV, P Starhis, SF Permuth, L Tokes and D Feldman. 1993. Bisphenol A, an estrogenic substance is released from polycarbonate flasks during autoclaving. Endocrinology 132:2279-2286.

Niwa T, M Tsutsui, K Kishimoto, Y Yabusaki, F Inhibashi and M Katagiri. 2000. Inhibition of drug-metabolizing enzyme activity in human hepatic cytochrome P450 by bisphenol A. Biol. Pharm. Bull 23:498-501.

Kim PG, EN Kwon and SH Hwang. 2000. Bisphenol A and nonylphenol concentrations in Kyonahn Cheon. Korean J. Environmental Health 26:107-113.

Santti R, M Akelas, L Struss, J Korkman and ML Kostian. 1998. Phytoestrogens : potential endocrine disruptors in males. Toxicol. Ind. Health 14:223-237.

vom Saal FS, PS Cooke, DL Buchanan, P Palanza, KA Thayer, SC Nagel, S Parmigiani

and WV Welshons. 1998. A physiologically based approach to the study of bisphenol A and other estrogenic chemicals in the size of reproductive organs, daily sperm production and behavior. Toxicol. Ind. Health 14:239-260.