1,4-BENZOQUINONE DIOXIME

Data were last reviewed in IARC (1982) and the compound was classified in *IARC Monographs* Supplement 7 (1987).

1. Exposure Data

1.1 Chemical and physical data

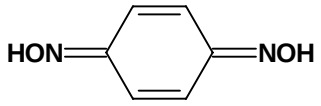
1.1.1 *Nomenclature*

Chem. Abstr. Services Reg. No.: 105-11-3

Systematic name: 2,5-Cyclohexadiene-1,4-dione, dioxime

Synonym: *para*-Benzoquinone dioxime

1.1.2 *Structural and molecular formulae and relative molecular mass*



$C_6H_6N_2O_2$ Relative molecular mass: 138.1

1.1.3 *Physical properties* (for details, see IARC, 1982)

(*a*) *Melting-point*: Decomposes at 240°C

(*b*) *Conversion factor*: $mg/m^3 = 5.65 \times ppm$

1.2 Production, use and human exposure

Occupational exposure to 1,4-benzoquinone dioxime probably occurs during its manufacture, its use as a rubber vulcanizing agent and its conversion to chemical derivatives (IARC, 1982).

2. Studies of Cancer in Humans

No data were available to the Working Group.

3. Studies of Cancer in Experimental Animals

1,4-Benzoquinone dioxime was tested for carcinogenicity in mice and rats by oral administration in the diet. No significant increase in the number of neoplasms was observed in male rats, but in females in the highest-dose group there was an increase in the number of transitional cell papillomas and carcinomas of the urinary bladder. In mice, no carcinogenic effect was observed (IARC, 1982).

4. Other Data Relevant to an Evaluation of Carcinogenicity and its Mechanisms

4.1 Absorption, distribution, metabolism and excretion

No data were available to the Working Group.

4.2 Toxic effects

4.2.1 *Humans*

No data were available to the Working Group.

4.2.2 *Experimental systems*

Slight increases in chronic inflammation and epithelial hyperplasia in the kidney in mice and rats and haemosiderosis of the spleen in rats of both sexes were observed in the carcinogenicity studies (IARC, 1982).

4.3 Reproductive and developmental effects

No data were available to the Working Group.

4.4 Genetic and related effects

4.4.1 *Humans*

No data were available to the Working Group.

4.4.2 *Experimental systems* (see Table 1 for references)

1,4-Benzoquinone dioxime induced mutations in bacteria and in cultured mouse lymphoma L5178Y cells, but not in *Drosophila melanogaster*. It gave inconclusive results for the frequency of transformed C3H 10T½ cells. In female rats treated *in vivo*, 1,4-benzoquinone dioxime did not induce either unscheduled DNA synthesis in hepatocytes or micronuclei in bone-marrow cells.

Table 1. Genetic and related effects of 1,4-benzoquinone dioxime

Test system	Result[a]		Dose[b] (LED or HID)	Reference
	Without exogenous metabolic system	With exogenous metabolic system		
SA0, *Salmonella typhimurium* TA100, reverse mutation	(+)	(+)	167	Haworth *et al.* (1983)
SA0, *Salmonella typhimurium* TA100, reverse mutation	+	?	167	Dunkel *et al.* (1985)[c]
SA5, *Salmonella typhimurium* TA1535, reverse mutation	–	–	250	Haworth *et al.* (1983)
SA5, *Salmonella typhimurium* TA1535, reverse mutation	–	–	1667	Dunkel *et al.* (1985)[c]
SA7, *Salmonella typhimurium* TA1537, reverse mutation	(+)	–	167	Haworth *et al.* (1983)
SA7, *Salmonella typhimurium* TA1537, reverse mutation	+	+	16.7	Dunkel *et al.* (1985)[c]
SA8, *Salmonella typhimurium* TA1538, reverse mutation	+	+	5	Dunkel *et al.* (1985)[c]
SA9, *Salmonella typhimurium* TA98, reverse mutation	+	+	5	Haworth *et al.* (1983)
SA9, *Salmonella typhimurium* TA98, reverse mutation	+	+	16.7	Dunkel *et al.* (1985)[c]
SA9, *Salmonella typhimurium* TA98, reverse mutation	+	+	1.5	Westmoreland *et al.* (1992)
ECW, *Escherichia coli* WP2 *uvr*A, reverse mutation	–	–	1667	Dunkel *et al.* (1985)[c]
DMX, *Drosophila melanogaster*, sex-linked recessive lethal mutations	–		3000 feed	Yoon *et al.* (1985)
G5T, Gene mutation, mouse lymphoma L5178Y cells, *tk* locus *in vitro*	+	NT	25	McGregor *et al.* (1988)
TCM, Cell transformation, C3H 10T½ mouse embryo cells *in vitro*	–	NT	5	Schechtman *et al.* (1987)
TCM, Cell transformation, C3H 10T½ mouse embryo cells *in vitro*	?	NT	5	Dunkel *et al.* (1988)[d]
UPR, Unscheduled DNA synthesis, female PVG rat hepatocytes *in vivo*	–		250 po × 1	Westmoreland *et al.* (1992)
MVM, Micronucleus test, female Fischer 344 rat bone-marrow cells *in vivo*	–		500 po × 1	Westmoreland *et al.* (1992)

[a] +, positive; (+), weak positive; –, negative; NT, not tested; ?, inconclusive
[b] LED, lowest effective dose; HID, highest ineffective dose; in-vitro tests, μg/mL; in-vivo tests, mg/kg bw/day; po, oral
[c] Independent testing in four laboratories
[d] Independent testing in two laboratories

5. Evaluation

No epidemiological data relevant to the carcinogenicity of 1,4-benzoquinone dioxime were available.

There is *limited evidence* in experimental animals for the carcinogenicity of 1,4-benzoquinone dioxime.

Overall evaluation

1,4-Benzoquinone dioxime is *not classifiable as to its carcinogenicity to humans (Group 3)*.

6. References

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