



**ANTHRACENE,
2-BROMOPROPANE,
BUTYL METHACRYLATE,
AND DIMETHYL
HYDROGEN PHOSPHITE**

VOLUME 133

This publication represents the views and expert opinions of an IARC Working Group on the Identification of Carcinogenic Hazards to Humans, which met in Lyon, France, 28 February to 7 March 2023

LYON, FRANCE - 2024

IARC MONOGRAPHS
ON THE IDENTIFICATION
OF CARCINOGENIC HAZARDS
TO HUMANS

CONTENTS

NOTE TO THE READER	1
LIST OF PARTICIPANTS	3
PREAMBLE	7
A. GENERAL PRINCIPLES AND PROCEDURES	7
1. Background	7
2. Objective and scope	8
3. Selection of agents for review	9
4. The Working Group and other meeting participants	9
5. Working procedures	11
6. Overview of the scientific review and evaluation process	12
7. Responsibilities of the Working Group	14
B. SCIENTIFIC REVIEW AND EVALUATION	15
1. Exposure characterization	15
2. Studies of cancer in humans	18
3. Studies of cancer in experimental animals	23
4. Mechanistic evidence	26
5. Summary of data reported	29
6. Evaluation and rationale	30
References	35
GENERAL REMARKS	39
ANTHRACENE	47
1. Exposure Characterization	47
1.1 Identification of the agent	47
1.2 Production and use	48
1.3 Detection and quantification	49
1.4 Occurrence and exposure	53
1.5 Regulations and guidelines	101
1.6 Quality of exposure assessment in key mechanistic studies in humans	102

2. Cancer in Humans	105
3. Cancer in Experimental Animals	105
3.1 Mouse	105
3.2 Rat	113
3.3 Rabbit	122
3.4 Evidence synthesis for cancer in experimental animals	123
4. Mechanistic Evidence	124
4.1 Absorption, distribution, metabolism, and excretion	124
4.2 Evidence relevant to key characteristics of carcinogens	129
4.3 Evaluation of high-throughput in vitro toxicity screening data	186
5. Summary of Data Reported	187
5.1 Exposure characterization	187
5.2 Cancer in humans	187
5.3 Cancer in experimental animals	187
5.4 Mechanistic evidence	188
6. Evaluation and Rationale	189
6.1 Cancer in humans	189
6.2 Cancer in experimental animals	189
6.3 Mechanistic evidence	189
6.4 Overall evaluation	189
6.5 Rationale	189
References	190

2-BROMOPROPANE	217
1. Exposure Characterization	217
1.1 Identification of the agent	217
1.2 Production and use	218
1.3 Detection and quantification	219
1.4 Occurrence and exposure	219
1.5 Regulations and guidelines	230
1.6 Quality of exposure assessment in key mechanistic studies in humans	230
2. Cancer in Humans	231
3. Cancer in Experimental Animals	232
3.1 Mouse	232
3.2 Rat	254
3.3 Evidence synthesis for cancer in experimental animals	261
4. Mechanistic Evidence	263
4.1 Absorption, distribution, metabolism, and excretion	263
4.2 Evidence relevant to key characteristics of carcinogens	264
4.3 Evaluation of high-throughput in vitro toxicity screening data	274
5. Summary of Data Reported	274
5.1 Exposure characterization	274
5.2 Cancer in humans	275
5.3 Cancer in experimental animals	275
5.4 Mechanistic evidence	276

6. Evaluation and Rationale.....	277
6.1 Cancer in humans.....	277
6.2 Cancer in experimental animals.....	277
6.3 Mechanistic evidence	277
6.4 Overall evaluation	277
6.5 Rationale	277
References.....	278
BUTYL METHACRYLATE.....	285
1. Exposure Characterization	285
1.1 Identification of the agent	285
1.2 Production and use.....	286
1.3 Detection and quantification.....	287
1.4 Occurrence and exposure.....	288
1.5 Regulations and guidelines	292
1.6 Quality of exposure assessment in key mechanistic studies in humans	293
2. Cancer in Humans	295
3. Cancer in Experimental Animals	295
3.1 Mouse	295
3.2 Rat	300
3.3 Evidence synthesis for cancer in experimental animals	301
4. Mechanistic Evidence.....	301
4.1 Absorption, distribution, metabolism, and excretion	301
4.2. Evidence relevant to key characteristics of carcinogens.....	303
4.3 Evaluation of high-throughput in vitro toxicity screening data	305
5. Summary of Data Reported	306
5.1 Exposure characterization	306
5.2 Cancer in humans	307
5.3 Cancer in experimental animals.....	307
5.4 Mechanistic evidence	307
6. Evaluation and Rationale.....	308
6.1 Cancer in humans	308
6.2 Cancer in experimental animals.....	308
6.3 Mechanistic evidence	308
6.4 Overall evaluation	308
6.5 Rationale	308
References.....	308
DIMETHYL HYDROGEN PHOSPHITE	313
1. Exposure Characterization	313
1.1 Identification of the agent	313
1.2 Production and use.....	314
1.3 Detection and quantification.....	314
1.4 Occurrence and exposure.....	315
1.5 Regulations and guidelines	315

2. Cancer in Humans	316
3. Cancer in Experimental Animals	316
3.1 Mouse	316
3.2 Rat	321
3.3 Evidence synthesis for cancer in experimental animals	323
4. Mechanistic Evidence	324
4.1 Absorption, distribution, metabolism, and excretion	324
4.2 Evidence relevant to key characteristics of carcinogens	325
4.3 Other relevant evidence	329
4.4 Evaluation of high-throughput in vitro toxicity screening data	330
5. Summary of Data Reported	331
5.1 Exposure characterization	331
5.2 Cancer in humans	331
5.3 Cancer in experimental animals	331
5.4 Mechanistic evidence	331
6. Evaluation and Rationale	332
6.1 Cancer in humans	332
6.2 Cancer in experimental animals	332
6.3 Mechanistic evidence	332
6.4 Overall evaluation	333
6.5 Rationale	333
References	333
LIST OF ABBREVIATIONS	337
ANNEX 1. Supplementary material for Section 1, Exposure Characterization	341
ANNEX 2. Supplementary material for Section 4, Evaluation of high-throughput in vitro toxicity screening data	343
SUMMARY OF FINAL EVALUATIONS	345