



**DRINKING COFFEE, MATE,  
AND VERY HOT BEVERAGES**

VOLUME 116

This publication represents the views and expert opinions of an IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, which met in Lyon, 24–31 May 2016

LYON, FRANCE - 2018

**IARC MONOGRAPHS  
ON THE EVALUATION  
OF CARCINOGENIC RISKS  
TO HUMANS**

# CONTENTS

---

<b>NOTE TO THE READER</b> .....	<b>1</b>
<b>LIST OF PARTICIPANTS</b> .....	<b>3</b>
<b>PREAMBLE</b> .....	<b>9</b>
<b>A. GENERAL PRINCIPLES AND PROCEDURES</b> .....	<b>9</b>
1. Background.....	9
2. Objective and scope.....	10
3. Selection of agents for review .....	11
4. Data for the <i>Monographs</i> .....	12
5. Meeting participants .....	12
6. Working procedures.....	13
<b>B. SCIENTIFIC REVIEW AND EVALUATION</b> .....	<b>14</b>
1. Exposure data.....	15
2. Studies of cancer in humans.....	16
3. Studies of cancer in experimental animals.....	20
4. Mechanistic and other relevant data.....	23
5. Summary .....	26
6. Evaluation and rationale.....	27
References.....	31
<b>GENERAL REMARKS</b> .....	<b>33</b>
<b>DRINKING COFFEE</b> .....	<b>36</b>
1. Exposure Data.....	37
1.1 Identification of the agent .....	37
1.2 Methods of production, uses, and preparation .....	40
1.3 Exposure assessment and biological markers.....	45
1.4 Chemical constituents.....	64
References.....	68

---

2. Cancer in Humans. . . . .	75
2.1 Cancer of the bladder. . . . .	75
2.2 Cancer of the pancreas. . . . .	144
2.3 Cancer of the liver. . . . .	176
2.4 Cancer of the breast in women. . . . .	204
2.5 Cancer of the endometrium. . . . .	241
2.6 Cancer of the prostate. . . . .	258
2.7 Cancer of the lung. . . . .	280
2.8 Cancer of the larynx. . . . .	285
2.9 Cancer of the ovary. . . . .	287
2.10 Childhood cancer. . . . .	293
2.11 Cancer of the oral cavity and pharynx. . . . .	297
2.12 Cancer of the oesophagus. . . . .	299
2.13 Cancer of the stomach, small intestine, gall bladder, and biliary tract. . . . .	300
2.14 Cancer of the colorectum. . . . .	301
2.15 Cancer of the kidney. . . . .	304
2.16 Malignant melanoma. . . . .	307
2.17 Non-melanoma cancer of the skin. . . . .	308
2.18 Adult cancer of the brain. . . . .	308
2.19 Adult haematopoietic cancers. . . . .	309
2.20 Other cancers. . . . .	309
2.21 All cancers combined. . . . .	310
References. . . . .	311
3. Cancer in Experimental Animals. . . . .	335
3.1 Studies of carcinogenicity. . . . .	335
3.2 Co-carcinogenicity and initiation–promotion studies. . . . .	340
References. . . . .	352
4. Mechanistic and Other Relevant Data. . . . .	355
4.1 Toxicokinetic data. . . . .	355
4.2 Mechanisms of carcinogenesis. . . . .	364
4.3 Genetic susceptibility. . . . .	392
4.4 Other effects. . . . .	395
References. . . . .	398
5. Summary of Data Reported. . . . .	413
5.1 Exposure data. . . . .	413
5.2 Human carcinogenicity data. . . . .	413
5.3 Animal carcinogenicity data. . . . .	418
5.4 Mechanistic and other relevant data. . . . .	419
6. Evaluation. . . . .	423
6.1 Cancer in humans. . . . .	423
6.2 Cancer in experimental animals. . . . .	423
6.3 Overall evaluation. . . . .	423

---

<b>DRINKING MATE AND VERY HOT BEVERAGES</b> .....	<b>425</b>
1. Exposure Data .....	425
1.1 Identification of the agent .....	425
1.2 Production and use .....	427
1.3 Production and consumption data .....	432
1.4 Methods of measurement and exposure assessment .....	432
2. Cancer in Humans .....	435
2.1 Mate .....	435
2.2 Very hot beverages other than mate .....	447
3. Cancer in Experimental Animals .....	474
3.1 Mate .....	474
3.2 Very hot water .....	476
4. Mechanistic and Other Relevant Data .....	477
4.1 Absorption, distribution, metabolism, and excretion of mate .....	477
4.2 Mechanisms of carcinogenesis .....	478
4.3 Other adverse effects .....	483
5. Summary of Data Reported .....	484
5.1 Exposure data .....	484
5.2 Human carcinogenicity data .....	485
5.3 Animal carcinogenicity data .....	486
5.4 Mechanistic and other relevant data .....	487
6. Evaluation .....	488
6.1 Cancer in humans .....	488
6.2 Cancer in experimental animals .....	488
6.3 Overall evaluation .....	488
6.4 Rationale .....	488
References .....	488
<b>LIST OF ABBREVIATIONS</b> .....	<b>495</b>

## NOTE TO THE READER

---

The term ‘carcinogenic risk’ in the *IARC Monographs* series is taken to mean that an agent is capable of causing cancer. The *Monographs* evaluate cancer hazards, despite the historical presence of the word ‘risks’ in the title.

Inclusion of an agent in the *Monographs* does not imply that it is a carcinogen, only that the published data have been examined. Equally, the fact that an agent has not yet been evaluated in a *Monograph* does not mean that it is not carcinogenic. Similarly, identification of cancer sites with *sufficient evidence* or *limited evidence* in humans should not be viewed as precluding the possibility that an agent may cause cancer at other sites.

The evaluations of carcinogenic risk are made by international working groups of independent scientists and are qualitative in nature. No recommendation is given for regulation or legislation.

Anyone who is aware of published data that may alter the evaluation of the carcinogenic risk of an agent to humans is encouraged to make this information available to the Section of IARC Monographs, International Agency for Research on Cancer, 150 cours Albert Thomas, 69372 Lyon Cedex 08, France, in order that the agent may be considered for re-evaluation by a future Working Group.

Although every effort is made to prepare the *Monographs* as accurately as possible, mistakes may occur. Readers are requested to communicate any errors to the Section of IARC Monographs, so that corrections can be reported in future volumes.