

## TABLE OF CONTENTS

|   |    |
|---|----|
| FOREWORD .....  | 1  |
| 1. EXECUTIVE SUMMARY .....  | 4  |
| 2. IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES .....                                  | 6  |
| 3. ANALYTICAL METHODS .....   | 6  |
| 4. SOURCES OF HUMAN AND ENVIRONMENTAL EXPOSURE .....                                | 7  |
| 4.1 Natural sources of benzoic acid .....   | 7  |
| 4.2 Anthropogenic sources .....   | 7  |
| 4.2.1 Benzoic acid .....  | 7  |
| 4.2.2 Sodium benzoate .....   | 7  |
| 4.3 Uses .....  | 7  |
| 4.3.1 Benzoic acid .....  | 7  |
| 4.3.2 Sodium benzoate .....   | 8  |
| 4.4 Estimated global release .....  | 8  |
| 5. ENVIRONMENTAL TRANSPORT, DISTRIBUTION, TRANSFORMATION, AND<br>ACCUMULATION ..... | 8  |
| 5.1 Transport and distribution between media .....                                  | 8  |
| 5.1.1 Benzoic acid .....  | 8  |
| 5.1.2 Sodium benzoate .....   | 8  |
| 5.2 Transformation .....  | 8  |
| 5.2.1 Benzoic acid .....  | 8  |
| 5.2.2 Sodium benzoate .....   | 9  |
| 5.3 Accumulation .....  | 10 |
| 5.3.1 Benzoic acid .....  | 10 |
| 5.3.2 Sodium benzoate .....   | 10 |
| 6. ENVIRONMENTAL LEVELS AND HUMAN EXPOSURE .....                                    | 11 |
| 6.1 Environmental levels .....  | 11 |
| 6.2 Human exposure .....  | 11 |
| 7. COMPARATIVE KINETICS AND METABOLISM IN LABORATORY ANIMALS AND<br>HUMANS .....    | 13 |
| 7.1 Precursors of benzoic acid .....  | 14 |
| 8. EFFECTS ON LABORATORY MAMMALS AND <i>IN VITRO</i> TEST SYSTEMS .....             | 14 |
| 8.1 Single exposure .....   | 14 |
| 8.2 Irritation and sensitization .....  | 15 |
| 8.2.1 Benzoic acid .....  | 15 |
| 8.2.2 Sodium benzoate .....   | 15 |
| 8.3 Short-term exposure .....   | 15 |
| 8.3.1 Oral exposure .....   | 15 |
| 8.3.2 Inhalation exposure .....   | 18 |
| 8.3.3 Dermal exposure .....   | 18 |

|        |  |    |
|--------|--|----|
| 8.4    | Long-term exposure   | 18 |
| 8.4.1  | Subchronic exposure  | 18 |
| 8.4.2  | Chronic exposure and carcinogenicity   | 18 |
| 8.4.3  | Carcinogenicity of benzyl acetate, benzyl alcohol, and benzaldehyde                            | 20 |
| 8.5    | Genotoxicity and related end-points  | 20 |
| 8.5.1  | Benzoic acid   | 20 |
| 8.5.2  | Sodium benzoate  | 20 |
| 8.6    | Reproductive and developmental toxicity  | 21 |
| 8.6.1  | Fertility  | 21 |
| 8.6.2  | Developmental toxicity   | 21 |
| 8.6.3  | Reproductive toxicity of benzyl acetate, benzyl alcohol, and benzaldehyde                      | 21 |
| 9.     | EFFECTS ON HUMANS  | 26 |
| 10.    | EFFECTS ON OTHER ORGANISMS IN THE LABORATORY AND FIELD   | 26 |
| 10.1   | Aquatic environment  | 26 |
| 10.2   | Terrestrial environment  | 28 |
| 11.    | EFFECTS EVALUATION   | 28 |
| 11.1   | Evaluation of health effects   | 28 |
| 11.1.1 | Hazard identification and dose-response assessment   | 28 |
| 11.1.2 | Criteria for setting tolerable intakes or guidance values for benzoic acid and sodium benzoate | 29 |
| 11.1.3 | Sample risk characterization   | 29 |
| 11.2   | Evaluation of environmental effects  | 30 |
| 12.    | PREVIOUS EVALUATIONS BY INTERNATIONAL BODIES   | 30 |
|        | REFERENCES   | 31 |
|        | APPENDIX 1 — SOURCE DOCUMENTS  | 39 |
|        | APPENDIX 2 — CICAD PEER REVIEW   | 39 |
|        | APPENDIX 3 — CICAD FINAL REVIEW BOARD  | 40 |
|        | APPENDIX 4 — INTERNATIONAL CHEMICAL SAFETY CARD  | 41 |
|        | RÉSUMÉ D'ORIENTATION   | 43 |
|        | RESUMEN DE ORIENTACIÓN   | 46 |