

[Home](#) > [Journal](#) > [Earth & Environmental Sciences](#) > [JEP](#)
[Indexing](#) | [View Papers](#) | [Aims & Scope](#) | [Editorial Board](#) | [Guideline](#) | [Article Processing Charges](#)
[JEP](#) > Vol.2 No.5, July 2011



Health Risk Assessment for Bromate (BrO_3^-) Traces in Ozonated Indian Bottled Water

PDF (Size: 1304KB) PP. 571-580 DOI: 10.4236/jep.2011.25066

Author(s)

Ajay Kumar, Sabyasachi Rout, R.K. Singhal

ABSTRACT

For this study, bromide and bromate ions in various commercial brands of Indian bottled water samples were estimated using ion chromatography. The measured mean concentration of bromide and bromate ions in water samples was found to be 28.13 $\mu\text{g/L}$ and 11.17 $\mu\text{g/L}$ respectively. The average level of bromate in Indian bottled water was found to be slightly higher (~ 12%) than the acceptable limits (10 $\mu\text{g/L}$) recommended by USEPA (US Environmental Protection Agency). Though, kinetically, it is predicted that 62.5% (6.25 $\mu\text{g/L}$) of bromide in bottled water is needed to convert into bromate upon ozonation to exceed the minimum acceptable limits, but the average formation of bromate determined to be only 26.77% of the predicted concentration. Bromate concentration in bottled water showed a strong correlation with bromide suggesting that its formation in water is very much influenced and controlled by bromide content. The objective of the present study was to determine the BrO_3^- content of commercially available different brands of bottled drinking water in India and to estimate the health risks to population due to ingestion. Results of estimated excess cancer risk and chemical toxicity risk to Indian population due to ingestion of bottled water were presented and discussed.

KEYWORDS

Bromide, Bromate, Excess Cancer Risk, Chemical Toxicity Risk, Bottled Water

Cite this paper

A. Kumar, S. Rout and R. Singhal, "Health Risk Assessment for Bromate (BrO_3^-) Traces in Ozonated Indian Bottled Water," *Journal of Environmental Protection*, Vol. 2 No. 5, 2011, pp. 571-580. doi: 10.4236/jep.2011.25066.

References

- [1] J. Lawrence, H. Tosine, F. I. Onuska and M. E. Comba, "The Ozonation of Natural Waters: Product Identification," *Ozone: Science and Engineering*, Vol. 2, No. 1, 1980, pp. 55-64. doi: 10.1080/01919518008550868
- [2] U. Von Gunten and J. Hoignt, "Bromate Formation during Ozonation of Bromide Containing Waters: Interaction of Ozone and Hydroxyl Radical Reactions," *Environmental Science & Technology*, Vol. 28, No. 7, 1994, pp. 1234-1242. doi: 10.1021/es00056a009
- [3] AWWARF, "Disinfection By-Products Database and Model Project," Denver, CO, American Water Works Association Research Foundation, 1991.
- [4] M. S. Siddiqui and G. Amy, "Factors Affecting DBP Formation during Ozone-Bromide Reactions," *Journal of the American Water Works Association*, Vol. 85, No. 1, 1993, pp. 63-72.
- [5] M. Siddiqui, G. Amy, K. Ozekin, W. Zhai and P. Westerhof, "Alternative Strategies for Removing Bromate," *Journal of the American Water Works Association*, Vol. 86, 1994, pp. 81-96.
- [6] IPCS, "Disinfectants and Disinfectant By-Products," World Health Organization, Geneva, 2000.
- [7] W. R. Haag and J. Hoigné, "Ozonation of Bromide-Containing Waters: Kinetics of Formation of Hypobromous Acid and Bromide," *Environmental Science & Technology*, Vol. 17, 1983, pp. 261-267.

- [Open Special Issues](#)
- [Published Special Issues](#)
- [Special Issues Guideline](#)

[JEP Subscription](#)
[Most popular papers in JEP](#)
[About JEP News](#)
[Frequently Asked Questions](#)
[Recommend to Peers](#)
[Recommend to Library](#)
[Contact Us](#)

Downloads:	301,517
Visits:	673,859

[Sponsors, Associates, and Links >>](#)

- [The International Conference on Pollution and Treatment Technology \(PTT 2013\)](#)

- [8] R. G. Rice and M. Gomez-Taylor, " Occurrence of By-Products of Strong Oxidants Reacting with Drinking Water Contaminants—Scope of the Problem," *Environmental Health Perspectives*, Vol. 69, 1986, pp. 31-44. doi:10.1289/ehp.866931
- [9] G. Gordon and G. L. Emmert, " Bromate Ion Formation in Water When Chlorine Dioxide Is Photolyzed in the Presence of Bromide Ion," *Proceedings of the Water Quality Technology Conference*, Denver, CO, American Water Works Association, New Orleans, 1996.
- [10] M. Fielding and J. Hutchison, " Formation of Bromate and Other Ozonation By-Products in Water Treatment," *Proceedings of the IWSA International Workshop on Bromate and Water Treatment*, Paris, 1993, London, International Water Supply Association, 1993, pp. 81-84.
- [11] J. Hoigné and H. Bader, " Kinetics of Reactions of Chlorine Dioxide (OCIO) in Water—I. Rate Constants for Inorganic and Organic Compounds," *Water Research*, Vol. 28, No. 1, 1994, pp. 45-55.
- [12] IARC, " Some Naturally Occurring and Synthetic Food Components, Furocoumarins and Ultraviolet Radiation," *International Agency for Research on Cancer, (IARC Monographs on the Evaluation of Carcinogenic Risks to Humans*, Lyon, Vol. 40, 1986, pp. 207-220.
- [13] IARC, " Some Chemicals That Cause Tumours of the Kidney or Urinary Bladder in Rodents and Some Other Substances," *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans*, International Agency for Research on Cancer, Lyon, Vol. 73, 1999, pp. 481-496.
- [14] US EPA, " Toxicological Review of Bromate in Support of Integrated Risk Information System (IRIS)," US Environmental Protection Agency, Washington DC, 2001.
- [15] US EPA, " Guidelines for Carcinogen Risk Assessment," US Environmental Protection Agency, Federal Register, Vol. 51, No. 185, 1999, pp. 33992-34003.
- [16] US EPA, " Guidelines for Carcinogen Risk Assessment (SAB Review Draft)," Washington, DC, US Environmental Protection Agency, Risk Assessment Forum (NCEA-F-0644), 1986.
- [17] US EPA, " Guidelines for Carcinogen Risk Assessment," SAB Review Draft, US Environmental Protection Agency, Risk Assessment Forum (NCEA-F-0644), Washington DC, 1999.
- [18] Health Canada, " Bromate. Guidelines for Canadian Drinking Water Quality—Supporting Document," Health Canada, Environmental Health Directorate, Health Protection Branch, Ottawa, Ontario, 1999.
- [19] Y. Kurokawa, " Dose–Response Studies on the Carcinogenicity of Potassium Bromate in F344 Rats after Long- Term Oral Administration," *Journal of the National Cancer Institute*, Vol. 77, 1986, pp. 977-982.
- [20] WHO, " Guidelines for Drinking Water Quality," Geneva, Vol. 1. 1993.
- [21] US EPA (United States Environmental Protection Agency), " Preliminary Health Risk Reduction and Cost Analysis, Revised National Primary Drinking Water Standards for Radionuclides," Review Draft, Washington DC, 2000.
- [22] Health Canada, " Summary of Guidelines for Canadian Drinking Water Quality," Federal-Provincial Subcommittee on Drinking Water of the Federal Provincial-Territorial Committee on Environmental and Occupational Health, Ottawa, Ontario, Canada, 1999.
- [23] WHO (World Health Organisation), " Guidelines for Drinking Water Quality," Addendum to: Health Criteria and Other Supporting Information, WHO/EOS/98.1, Geneva, Vol. 2, 2nd Edition, 1998, p. 283.
- [24] US EPA (United States Environmental Protection Agency), " EPA Standard Default Exposure Factors," Washington DC, 1991.
- [25] HDR (Human Development Report), " National Resource Centre for urban poverty and All India Institute of Local Self Government, Mumbai, India," 2009.