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Bromine Levels in Human Serum, Urine, Hair

Short Communication

R. E. CUENCA, W. J. PORIES,* AND J. BRAY

The Departments of Surgery and Shared Research Resources Laboratories, East Carolina University School of Medicine, Greenville, NC 27834

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ABSTRACT

Much is known about the essentiality of the halogens fluorine (F), chlorine (Cl), and iodine (I), but very little has been discussed with respect to bromine (Br). As a member of the halogen family its chemical properties are comparable to those of other halogens, but its presence has been masked by the presence of I and Cl in chemical analyses. By virtue of new technology and a special computerized machine called the Kevex Model 0600 Energy Dispersive X-Ray Induced X-Ray Fluorescence Spectrometer (EDXRF), we can specifically identify bromine in different compartments and verify its concentration accurately. In order to establish standard values of Br concentrations and evaluate the nature of its presence in humans, samples of serum, urine, and hair were collected from ten healthy adult males and analyzed for bromine content. Our samples had normal distributions, with serum bromine levels ranging from 3.2 to 5.6 μg/mL, urine levels between 0.3 to 7.0 μg/mL, and hair levels determined from 1.1 to 49.0 μg/mL. These levels, especially those of serum bromine, have been encountered by other examiners whose samples also had normal distributions. These findings suggest to us that bromine may well be an essential trace element, as are its other halogen family members.

*Author to whom all correspondence and reprint requests should be addressed.

Index Entries: Bromine, distribution of in human serum, urine, and hair; essential trace elements; analysis by X-ray induced X-ray fluorescence.

INTRODUCTION

The periodic table strongly suggests that bromine, as the other halogens, should be essential for life, but until recently we have not been able to measure the bromine content of tissues with sufficient accuracy. Difficulties with the chemical measurements for bromine probably account for the sparse literature in this area. A new technology, the new Kevex Model 0600 Energy Dispersive X-Ray Induced X-Ray Fluorescence Spectrometer (EDXRF), however has made it feasible to perform bromine determinations in biologic materials. Our initial findings in normal volunteers suggest that bromine is a closely regulated ion and, accordingly, necessary for health.

METHODS

For the initial study we selected a random sample of ten healthy adult males (ages 26–31). One sample of venous blood was collected in a Royal Blue top vacutainer from each subject. On the same day of blood collection the first morning void of urine was also collected in containers approved for trace element analysis. A small sample of hair was also obtained from each volunteer. Blood samples were spun and the serum separated. The urine samples were digested with nitric acid to allow for thin layering of the liquid. The samples of serum, urine, and hair were analyzed for total bromine content (free and bound) using the EDXRF. Each sample was run in duplicate to test for reproducibility. The results were expressed as mean ± standard deviation (SD).

RESULTS

Bromine levels in serum, urine, and hair are given in Table 1. Data analysis is given in Table 2.

DISCUSSION

The random samples had normal distributions which Leidscher and Smith purport to be a characteristic of an essential trace element (*1*). Our serum levels ranged from 3.2–5.6 μg/mL (ppm). Versieck and Cornelius (*2*) found their average serum bromine levels to be between 1.3–7.5 ppm. Rapaport et al. (*3*) found an average serum bromine level of 7.38 ppm, and Alfassi and Lavi (*4*) found an average of 6.1 ppm by X-ray spectro-

Table 1
Bromine Levels in Selected Human Serum, Urine, and Hair[a]

Subject Code	Serum	Urine	Hair
A	4.0	4.2	1.1
B	5.6	7.0	2.7
C	3.6	1.8	6.3
D	3.2	2.9	2.3
E	4.1	3.3	3.2
F	3.7	1.2	4.0
G	3.6	3.8	2.4
H	3.7	2.9	1.3
I	3.8	3.7	1.3
J	3.5	0.3	49.0

[a]Bromine levels are expressed in μg/mL.

metry. Other reports have been within this normal range (*5*). Cross and Smith (*6*) have studied urine, hair, and other tissues and found normal distributions among their samples. Their urine bromine levels ranged from 5.1–16.4 ppm and their hair levels ranged from 5.1–61.6 ppm. Our urine and hair levels were somewhat lower (0.3–7.0 ppm and 10.9–49.0 ppm, respectively), but our serum levels were consistent with those of other reports. Since urine and hair are "excretory" tissues, we might expect differences in bromine levels between individuals. It is interesting to note that sample J had a very high hair bromine level when compared to his counterparts. He reported taking a daily multivitamin and swimming two to three times per week in an indoor swimming pool which uses bromine as a disinfectant. No other subjects reported the use of medications or supplements and few frequented this swimming pool. No extraneous uses of hair tonics or shampoos was reported by any subject. Sample J also had much lower urine bromine levels, which we cannot explain at this time.

These findings suggest to us that bromine may well be an essential trace element, as are its other halogen family members. Presently our department is evaluating bromine levels in disease states to see how they vary from those of healthy individuals.

Table 2
Data Analysis[a]

Tissue	Range	Mean	Median	SD[b]	95% Confidence Interval
Serum	3.2 – 5.6	3.9	3.7	1.1	3.9 ± 0.66
Urine	0.3 – 7.0	3.1	3.1	4.3	3.1 ± 2.7
Hair	1.1 – 49.0	7.4	2.6	27.9	7.4 ± 17.3
Hair[c]	1.1 – 6.3	2.7	2.4	2.3	2.7 ± 1.5

[a]Bromine levels expressed in μg/mL.
[b]Standard Deviation
[c]Omitting outlier (Sample J)

REFERENCES

1. K. Liebscher and H. Smith, *Arch. Environ. Health* **17,** 882 (1968).
2. J. Versieck and R. Cornelius, *Analytica Chim. Acta.* **116,** 217 (1980).
3. M. S. Rapaport, M. Mantel, and R. Nothmann, *Anal. Chem.* **51**(9), 1356 (1979).
4. Z. B. Alfassi and N. Lavi, *Anal. Chem.* **55**(4), 796 (1983).
5. J. D. Cross, R. M. Raie, and H. Smith, *J. Clin. Pathol.* **34**(4), 393 (1981).
6. J. D. Cross and H. Smith, *Forensic Science.* **11,** 147 (1978).