**BRAZILIAN ARCHIVES OF
BIOLOGY AND TECHNOLOGY**

A N   I N T E R N A T I O N A L   J O U R N A L

Erratum

In Article "Chemical quality of bottled mineral waters from markets of Curitiba-PR-Brazil", with the number of DOI: http://dx.doi.org/10.1590/1678-4324-2016160111, published in journal Brazilian Archives of Biology and Technology, vol. 59, the 01 page. That read:

"Éder José dos Santos[1*],Dasio Roberto de Oliveira Junior[1], Amanda Beatriz Hermann[1],Ralph Edwatd Sturgeon[2].

[1] Instituto de Tecnologia do Paraná – TECPAR – Centro de Tecnologia em Saúde e Meio Ambiente, Curitiba, Paraná, Brasil; [2]Measurement Science and Standards, NationalResearchCouncil Canada, Ottawa, Canada.**"**

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"In these studies, the concentrations ofinorganicions as well as parameterssuch aspH, electrolyticconductivity and inorganicand total organiccarbon were determined. For thispurpose, the main analytical techniques employed were ion chromatography (IC), inductively coupled plasma optical emission spectrometry (ICP OES) and inductively coupled plasma mass spectrometry (ICP-MS). In Brazil, studies have also highlightedconcern over thequality and compositionof bottled mineral waters available on the market. Godoy et al. investigated the natural radionuclides ^{228}Ra, ^{226}Ra and ^{210}Pb in Brazilian bottled mineral waters (Godoy et al., 2001)."

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Table 1. ICP OES, CVG-ICP OES and ICP-MS instrumental parameters.

	ICP OES	CVG-ICP OES	ICP-MS
Radiofrequency	40 MHz	40 MHz	27.12 MHz
Forward power	1.25 kW	1.2 kW	1.4 kW
Plasma gasflow rate	15.0 L min^{-1}	15.0 L min^{-1}	18.0 L min^{-1}
Auxiliarygasflow rate	1.5 L min^{-1}	1.5 L min^{-1}	1.8 L min^{-1}
Sheathgasflow	----------------	----------------	0.21 L min^{-1}
Carrier gas flow rate	----------------	120 mL min^{-1}	----------------
Nebulizerpressure	180 kPa	----------------	----------------
Nebulizertype	Concentricglass K	----------------	----------------
Spray chamber	Standard Axial Varian	Standard Axial Varian	----------------
Replicateread time	15 s with 4 replicates	15 s with 4 replicates	20 s with 8 replicates
Torchtype	1.8 mm I.D. alumina injector tube	Quartz for axial view	Quartz
NaBH$_4$ concentration	----------------	0.3 % (m/v) in 0.4%, m/v, NaOH	----------------
HCl concentration	----------------	5 mol L^{-1}	----------------
Analytical lines / isotopes (ICP-MS)	Al: 396.152 nm, Ba: 455.403 nm, Cd: 214.439 nm, Cr: 267.716 nm, Cu: 327.395 nm; Fe: 238.204 nm, Li: 610.365 nm, Mn: 257.610 nm, Ni:231.604 nm, Sr: 421.552 nm, V: 292.401 nm, Zn: 213.857 nm	Hg: 252.652 nm	^{75}As, ^{121}Sb, ^{206,207,208}Pb and^{78}Se
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"**Reagents and samples:** All chemicals were of analytical grade, unless otherwise specified. High-purity water (18.2 M□ cm resistivity) was de-ionized in a Milli-Q system (Bedford, MA, USA). The following Merck reagents (Darmstadt, Germany) were used: NaBH$_4$ to prepare a 0.3 % m/v solution in NaOH; 65% v/v HNO$_3$suprapur® ; 37% v/v HCl from which a 5 mol L^{-1} solution was prepared. Buffer solutions for pH 4.00 and pH 7.00 were supplied by Êxodo (Hortolândia, Brasil). Monoelemental standard solutions containing 1000 □g mL^{-1} of Al, As, Hg, In, K$^+$, Mn, Na$^+$, Pb, Se, Sb, Sr, V, Y, Zn, Cl$^-$, NO$_2^-$ and NH$_4^+$were obtained from AccuStandard (New Haven, USA); those for Ba, Cd, Cr, Ca^{2+}, Cu, Fe, Li, Mg^{2+} and Ni from UltraScientific (North Kingstown, USA), while solutions of F$^-$, NO$_3^-$ and SO$_4^{2-}$ were supplied by FlukaAnalitical (St. Louis, USA). A conductivity standard of 84 μS cm^{-1} was obtained from Mettler Toledo. Quality control Certified Reference Materials comprising acidified aqueous solutions containing 100 μg mL^{-1} As, Sb, Ca, Cd, Cr, Cu, Fe, Li, Mg, Mn, Ni, Pb, Se, Sr, V and Zn (QCS-01-5), 100 μg mL^{-1} of Al, Ba, K and Na (QCS-02-R1-5) and 20 μg mL^{-1} of Hg (TCLP-02-1) were obtained from AccuStandard. These served asquality control standards."

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Table 4. Figures of merit and results for analysis of quality control materials and standards (n=7).

Analyte	Linear correlationcoefficients	Limit of detection (µg L^{-1})	Limit of quantification (µg L^{-1})	expected concentration (µg L^{-1})	recovery	RSD, %
Al	0.9998	2	10	10.0	10.0 ± 0.2	2.0
As	0.9997	0.1	1.0	10.0	10.3 ± 0.2	1.9
Ba	0.9999	1	5	10.0	11.0 ± 0.1	0.9
Ca^{2+}	0.9999	10	100	100	106 ± 4	4
Cd	0.9999	0.2	1.0	10.0	9.6 ± 0.1	1.0
Cu	0.9996	1	10	10.0	10.1 ± 0.2	2.0
Cr	0.9999	0.2	1.0	10.0	9.8 ± 0.1	1.0
Cl$^-$	0.9999	30	100	100	101 ± 10	10
F$^-$	0.9993	1	20	10.0	9.1 ± 0.3	3.3
Fe	0.9999	2	10	10.0	10.5 ± 0.1	1.0
Hg	0.9980	0.04	0.2	1.0	0.9 ± 0.03	3.3
K$^+$	0.9999	10	100	100	102 ± 3	3
Li	0.9996	2	10	10.0	11.2 ± 0.2	1.8
Mn	0.9999	0.2	1.0	10.0	10.2 ± 0.2	1.8
Mg^{2+}	0.9999	5	100	100	98 ± 2	2
NO$_3^-$	0.9999	5	100	100	89 ± 1	1
NO$_2^-$	0.9999	1	10	10.0	10.2 ± 0.3	2.9
NH$_4^+$	0.9999	10	30	30.0	33.0 ± 2.1	6.4
Na$^+$	0.9999	10	100	100	100 ± 4	4
Ni	0.9999	2	10	10.0	9.5 ± 0.3	3.2
Pb	0.9995	0.1	1.0	10.0	10.2 ± 0.2	2.0
Sb	0.9996	0.2	1.0	10.0	11.1 ± 0.3	2.7
Sr	0.9997	1	5	10.0	10.0 ± 0.1	1.0
Se	0.9987	0.1	1.0	10.0	10.1 ± 0.1	1.0

Analyte	Linear correlation coefficients	Limit of detection ($\mu g\ L^{-1}$)	Limit of quantification ($\mu g\ L^{-1}$)	expected concentration ($\mu g\ L^{-1}$)	recovery	RSD, %
SO_4^{2-}	0.9999	10	100	100	98 ± 2	2.0
V	0.9999	2	10	10.0	9.0 ± 0.1	1.1
Zn	0.9999	2	10	10.0	9.6 ± 0.3	3.1

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"Tables 5 and 6 summarize results obtained characterizing the twenty-seven commercial samples purchased for this study. The presence of NH_4^+ and NO_2^- are indicative of microbiological contamination. The concentration of NH_4^+ was below the limit of quantification but for NO_2^- samples 14, 19 and 21 (0.01 mg L^{-1}) concentrations nearthemaximum limit setby Brazilian legislation were evident whereas that for sample 16 (0.04 mg L^{-1}) exceeded the maximum limit set by RDC N° 274, 2005, i.e., 0.02 mg/L. "

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"Iron is only detected in two imported samples from Italy: 10 μg L^{-1} (sample 26) and 21 μg L^{-1} (sample 27), but its concentration is notdeclared on the sample labels.Selenium is present in the range 1.2 - 6.4 μg L^{-1} (four samples) and V in the range 10 -150 μg L^{-1} (ten samples). Sample 24, imported from France, and sample 17, from Paraná State, are identified as containing the highest concentrations of Se: 6.4 ± 0.3 μg L^{-1} and V: 150 ± 5 μg L^{-1}, respectively. According to Brazilian legislation, these samples should also beclassified as mineral waters "seleniada", i.e., that containselenium at minimum 6 μg L^{-1} and maximum of 10μg L^{-1}, and "vanadica", i.e.,that contain vanadium at minimum 30μg L^{-1} (Portaria DNPM 540, 2014 and RDC N° 274, 2005). However, no statementon the label can be found. With respect to trace element content and potential contaminants, all samplesshould have more information concerning their concentrations."

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"Although the physico-chemical parameter pH showed values different from those declared on the labels, as summarized in Table 3, these differences were not significant and in these cases the producers indicate that the values correspond to those characterizing the source of the water. These differences are acceptable since chemical transformations may occur over time that could slightly affect the pH.The pH range varies from mildly acidic (5.53 ± 0.01, sample 23) toslightlyalkaline (8. 89 ± 0.10, sample 24). Alkalinitydueto the presence of CO_3^{2-} was detected in four sampleswherein thereported pHwas8.49 ± 0.01 (sample 14), 8.79 ± 0.03 (sample 17), 8.44 ± 0.05 (sample 19) and 8.89 ± 0.01 (sample 24). Figure 1shows thecorrelation betweenconductivity and total dissolved solids (TDS)parameterswhich indicatesthat the higher thesample conductivity, the greater the amount ofTDS present. These two parameters are strongly correlated, especially with imported samples 24 (France), 25 (Portugal) and 26 (Italy). Conductivity is in close agreement with declared values except for sample 01 for which a value of 3.7 ± 0.1 μS cm $^{-1}$ was determined whereas 153 μS cm $^{-1}$ declared, and the producer will require notification."

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"Likewise,thehardnesspresent in the samplecan be correlatedmainlyto the presenceof Ca and Mg. Samples24-26 are again highlighted for their significant values present. The main constituent elements reportedon the sample labels include: HCO_3^-, F^-, Cl^-, NO_3^-, SO_4^{2-}, Na^+, K^+, Mg^{2+}, Ca^{2+}, Ba, Li and Sr. Principal component analysis (PCA) for the concentrations of these analytes is presented in Figure 2, where PC1 is the first principal component, PC2 is the second and PC3 is the third (Dos Santos et al., 2008, Dos Santos et. al., 2012 and Miller, J. N. and Miller, J. C, 2000). PC1 accounts for 47% of the variance of the data and discriminates samples through the influence of parameters related to HCO_3^-, F^-, Cl^-, Ca^{2+}, and Li. PC2 accounts for 17% of the variance of the data and discriminates samples on the basis of SO_4^{2-}, while PC3 accounts for 12% of the variance of the data and is mainly correlated with the presence of Ba and Sr. Together, 76% of the variability of the original data is thus accounted for. As evident from Figure 2, the samples are clustered in a main group but five are located in differentregions of thegraph. Samples 23 to 26 are imported: 23 and 24 from France, 25 from Portugal and 26 from Italy. Only sample 22 is from Minas Gerais State, Brazil. Is evident that these samples havedifferentphysicochemicalcompositions, being characterized by relatively high concentrations of salts, manly HCO_3^- and Sr. Legislation does not specify a value for Sr, and the HCO_3^- ion is an essential component of mineral waters (Decreto-Lei 7841, 1945). These fivesamplesare also rich inF^-, providing a classification as "fluoridated mineral water", as defined by Brazilian legislation (Portaria DNPM 540, 2014). The concentration of Li is high in samples 22, 24, 25 and 26, also a characteristic of mineral water in accordance with Brazilian legislation (Portaria DNPM 540, 2014). The concentration of Ba in sample 22 is the highest: 386 ± 5 µg L^{-1}, but below the maximum specified by Brazilian legislation, i.e., 700 µg L^{-1} (RDC N° 274, 2005). The main cluster comprises the majority of the samples that are bottled in the State of Paraná, with the exception of sample 11 from São Paulo State and sample 27 from Italy. This cluster is characteristic of the presence of NO_3^-. Nitrate may have either a mineral or microbiological origin. Its determinable concentration ranges from 0.10 mg L^{-1} - 63.05 mg L^{-1} while samples 01, 15 and 25 are below the LOQ. Only sample 10 (63.05 mg L^{-1}) is above the maximum specified by Brazilian legislation, i.e., 50 mg/L (RDC N° 274, 2005), **but the label states a value of 3.47 mg L^{-1} (Table 3)**. The elevated concentration may be indicative of microbiological contamination which may be harmful tohuman health (Astel et al., 2014). Samples 01, 10 and 21 are classified as "fluoridated mineral water", according to their labels; however, in this study, F$^-$wasnot detectedabove0.02 mg L^{-1},theminimum, according to Brazilian legislation

(Portaria DNPM 540, 2014), needed forwaterto beclassified as such. Since the declared valuesare close to the minimum, analytesorptionby the packagingmaterials may have occurred. It is evident that samples 3 and 4 have the same mineral composition. In reality, these samples are from the same region (Apucarana city, State of Paraná), but on the market they have a different identification and no indication that they are from the same producer. In general, it is clear that information declared on the label is different from that arising from analysis of the samples in this work, but it must also be recognized that as the samples are rich in salts, several factors may lead to changes in the composition, however small, including decomposition of HCO_3^-, sorption of analytes onto the walls of the container material, the time on the market shelf, and proper care during transport and the ambient storage temperature. To make a more qualified analysis of the national samples, a scatter plot based on only national Brazilian samples is presented in Figure 3. Here the PCs account for 73% of the variability of the original data. As in Figure 2, variability in the compositions of samples are evident wherein the difference of mineral content of sample 22 in relation to others is evident. The sample 10 possibly is contaminated and the samples 15 and 17 show F^- content and Na^+ higher concentrations than others.Clearly, the PCA statistical tool can be very useful for identification

andcomparison ofcompositionsof bottled mineral waters on the market.**"**

Read:
"Likewise, the hardenss present in the sample can be correlated mainly to the presence of Ca and Mg. Samples 24-26 are again highlighted for their significant values present. The main constituent elements reported on the sample labels include: HCO_3^-, F^-, Cl^-, NO_3^- , SO_4^{2-}, Na^+ , K^+ , Mg^{2+}, Ca^{2+}, Ba, Li and Sr. Principal component analysis (PCA) for the concentrations of these analytes is presented in Figure 2, where PC1 is the first principal component, PC2 is the second and PC3 is the third (Dos Santos et al., 2008, Dos Santos et. al., 2012 and Miller, J. N. and Miller, J. C, 2000). PC1 accounts for 47% of the variance of the data and discriminates samples through the influence of parameters related to HCO_3^-, F^-, Cl^-, Ca^{2+}, and Li. PC2 accounts for 17% of the variance of the data and discriminates samples on the basis of SO_4^{2-}, while PC3 accounts for 12% of the variance of the data and is mainly correlated with the presence of Ba and Sr. Together, 76% of the variability of the original data is thus accounted for. As evident from Figure 2, the samples are clustered in a main group but five are located in different regions of the graph. Samples 23 to 26 are imported: 23 and 24 from France, 25 from Portugal and 26 from Italy. Only sample 22 is from Minas Gerais State, Brazil. Is evident that these samples have different physicochemical compositions, being characterized by relatively high concentrations of salts, manly HCO_3^- and Sr. Legislation does not specify a value for Sr, and the HCO_3^- ion is an essential component of mineral waters (Decreto-Lei 7841, 1945). These five samples are also rich in F^-, providing a classification as "fluoridated mineral water", as defined by Brazilian legislation (Portaria DNPM 540, 2014). The concentration of Li is high in samples 22, 24, 25 and 26, also a characteristic of mineral water in accordance with Brazilian legislation (Portaria DNPM 540, 2014). The concentration of Ba in sample 22 is the highest: 386 ± 5 μg L^{-1}, but below the maximum specified by Brazilian legislation, i.e., 700 μg L^{-1} (RDC N° 274, 2005). The main cluster comprises the majority of the samples that are bottled in the State of Paraná, with the exception of sample 11 from São Paulo State and sample 27 from Italy. This cluster is characteristic of the presence of NO_3^-. Nitrate may have either a mineral or microbiological origin. Its determinable concentration ranges from 0.10 mg L^{-1} - 63.05 mg L^{-1} while samples 01, 15 and 25 are below the LOQ. Only sample 10 (63.05 mg L^{-1}) is above the maximum specified by Brazilian legislation, i.e., 50 mg/L (RDC N° 274, 2005), but the label states a value of 3.47 mg L^{-1} (Table 3). The elevated concentration may be indicative of microbiological contamination which may be harmful to human health (Astel et al., 2014). Samples 01, 10 and 21 are classified as "fluoridated mineral water", according to their labels; however, in this study, $F^-$was not detected above0.02 mg L^{-1},the minimum, according to Brazilian legislation (Portaria DNPM 540, 2014), needed for water to be classified as such. Since the declared values are close to the

minimum, analyte sorptionby the packaging materials may have occurred. It is evident that samples 3 and 4 have the same mineral composition. In reality, these samples are from the same region (Apucarana city, State of Paraná), but on the market they have a different identification and no indication that they are from the same producer. In general, it is clear that information declared on the label is different from that arising from analysis of the samples in this work, but it must also be recognized that as the samples are rich in salts, several factors may lead to changes in the composition, however small, including decomposition of HCO_3^-, sorption of analytes onto the walls of the container material, the time on the market shelf, and proper care during transport and the ambient storage temperature. To make a more qualified analysis of the national samples, a scatter plot based on only national Brazilian samples is presented in Figure 3. Here the PCs account for 73% of the variability of the original data. As in Figure 2, variability in the compositions of samples are evident wherein the difference of mineral content of sample 22 in relation to others is evident. The sample 10 possibly is contaminated and the samples 15 and 17 show F^- content and Na^+ higher concentrations than others. Clearly, the PCA statistical tool can be very useful for identification and comparison of compositionsof bottled mineral waters on the market.**”**

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"nd: notdetected; legislation: Portaria Nº 540 de 18/12/2014[1],RDC N° 274 de 22/09/2005[2], Portaria N° 2914 de 12/12/2011[3].**”**

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The present study reveals that, in general, the majority of parameters determined in commercial bottled mineral waters from markets in Curitiba-PR-Brazil are below limits specified by Brazilian legislation. Only one sample was detected as having a high concentration of NO_3^-, indicating microbiological contamination; some results for NO_2^- may also reflect the same contamination. Improvements in monitoring throughout the process of filling and points of sale of the samples, with the aim of securing the microbiological quality of bottled mineral waterssold in the region under study may be needed. The comparison of labelled composition to analytical results highlights a difference for mostelements, but it should be noted that intrinsic instabilityas well asother factors such assorption of components onto container surfaces as well as the length of time spent on the shelf, care during transport, and the ambient storage temperature may alter the composition; perhaps a "best before date" could eliminate such discrepancies. In such cases,a furtherstudy of thestability andinteractionwith thepackaging should be performed. Although a perfect division of samples from

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