An Investigation into the Potential Anticaries Benefits and Contributions to Mineral Intake of Bottled Water

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Abstract

Background. Bottled water has become the most consumed beverage in the United States. Our study aimed to inform the dental profession of the potential anticaries benefits of some bottled water and to provide information about their possible contributions to fluoride, calcium, magnesium, sodium, and potassium intakes.

Methods. We chose a convenience sample by purchasing all different bottled waters from the main supermarkets operating in Indianapolis, IN. We analyzed the fluoride content using a fluoride ion-specific electrode and metal concentrations using atomic absorption spectroscopy. We used dietary reference intakes to calculate hypothetical intakes of all minerals.

Results. We identified 92 different bottled waters. Fluoride concentrations were generally very low (mean/median: 0.11/0.04 ppm). Only two waters contained more than 0.7 ppm fluoride (0.95 ppm; 1.22 ppm). Metal concentrations varied considerably among waters. Calcium ranged from <0.1-360 ppm (mean/median: 26.9/5.2 ppm), more so than magnesium (range: <0.01-106 ppm; mean/median: 7.5/1.9 ppm), sodium (range: <0.01-109 ppm; mean/median: 11.1/2.9 ppm) and potassium (range: <0.01-43 ppm; mean/median: 3.6/1.2 ppm). Overall, the vast majority of bottled waters do not contribute to adequate intakes of fluoride, potassium or sodium, or to recommended dietary allowances for calcium and magnesium. Nonetheless, some waters can provide meaningful contributions to fluoride, calcium and magnesium intake.

Conclusions. The fluoride concentration in 90 of the 92 studied bottled waters is insufficient to contribute to caries prevention. Only very few bottled waters can be considered health-promoting.

Practical Implications. Dental professionals should consider the mineral content of water consumed by their patients during caries risk assessment.

Key words. Bottled water, Fluoride, Calcium, Magnesium, Potassium, Sodium, Dental Caries, Dietary reference intakes

INTRODUCTION

Bottled water has become increasingly popular due to its convenience, pleasing taste, and perceived purity.[1] In 2016, bottled water became the most consumed non-alcoholic, commercial beverage in the United States.[2] The Food and Drug Administration (FDA) regulates bottled water and defined a nomenclature (Table 1). Drinking water supplied by public water supplies (i.e., tap water), however, is regulated by the Environmental Protection Agency (EPA)[3] and is not considered a commercial beverage.

Bottled water consumption contributes significantly to total water intake.[4] Data from the 2011-2016 National Health and Nutrition Examination Survey (NHANES) revealed that bottled water contributed 38% of the total drinking water volume in those aged 4 years and above[4]. Further age, ethnic and racial differences were found, with, for example, Mexican-American adults consuming 1.5 times as much bottled as tap water.[4]

Fluoridation of community water supplies (i.e., tap water) is considered an important public health measure to deliver cariostatic amounts of fluoride, reaching 72.8% of the population in the United States on community water systems in 2016.[5] While the anticaries benefits of community water fluoridation have been widely recognized,[6] the replacement of tap in favor of bottled water has been hypothesized to have a negative impact on oral health.[7] In comparison to tap water, the majority of commercially available bottled waters have been reported to contain inadequate levels of fluoride needed for caries prevention. Bottled waters can also provide other minerals, such as calcium, magnesium, potassium and sodium, which are important for health and maintenance of bodily functions. A previous study highlighted considerable differences in mineral concentrations between and within tap and bottled waters.[8] However, these studies were conducted at least one decade ago. Considering the aforementioned developments in the bottled water market a renewed analysis seemed prudent and also since previous studies into the mineral content of bottled waters in the United States have analyzed either fluoride or calcium (and other metal) ion concentrations but not in tandem.[6,8,9]

Therefore, we decided to analyze the fluoride, calcium, as well as magnesium, potassium and sodium ion concentrations of bottled waters available in Indianapolis, IN, US. As a secondary aim, we also wanted to provide information about the potential contributions of bottled waters to fluoride, calcium, magnesium, potassium and sodium intakes by comparing our data to the dietary reference intakes (DRI) developed by the (United States) National Academies of Sciences, Engineering, and Medicine.

METHODS

Sampling Procedure. Bottled water is commercially available in the U.S. from a wide variety of retail outlets. As sampling all was beyond the scope of our study, we chose a convenience sample by focusing on the main supermarket and variety store chains operating in Indianapolis, IN. After purchase (July-August 2019), we transported all water samples to the Oral Health Research Institute at Indiana University and stored them under ambient conditions until analysis. We did not sample a) flavored bottled waters as they were beyond the scope of the present study; b) seltzer and club soda as these were outside the definition of bottled water according to the FDA (see Table 1); c) nursery waters as they are intended only for babies and toodlers and used to mix with, for example, infant formula; and d) distilled waters sold in one-gallon bottles as they are free of any minerals by virtue of being distilled water. We did, however, include distilled waters with added minerals (as disclosed on the bottle label) in the present study.

Fluoride Analysis. We determined the fluoride concentration of all samples by using a fluoride ion-specific electrode (Orion #96-909-00) as described by Martínez-Mier et al.[10] For each water sample, we added 1 mL of total ionic strength adjustment buffer II (Fisher Scientific) to a 1-mL aliquot of the bottled water in a polyethylene vial (7-mL vial; Fisher Scientific). Then we mixed the solution using a vortex mixer and placed it under the electrode. Finally, we compared the millivolt reading of each sample to a standard curve to obtain the fluoride content values.

Calcium, Magnesium, Potassium and Sodium Analyses. We determined the metal contents by atomic absorption spectrometer (ICE 3000 Series-Thermo, England), equipped with background correction (a deuterium lamp) as well as other cathode lamps at a wave length of 422.7 nm , 285.2 nm , 589.0 nm and 766.5 nm suitable for calcium, magnesium, sodium and potassium, respectively. The applied concentrations of the standard solutions covered the measurement range of the analytical method, which was characterized by the linearity of the calibration curves.[11,12] To a polyethylene vial (7-mL vial; Fisher Scientific), we added l mL of lanthanum chloride to different volumes of deionized water and an aliquot of each bottled water to ensure that all measured concentrations did fall in the measurement range that was determined previously.

Water hardness. We calculated the water hardness of each bottled water utilizing the measured sum of calcium and magnesium concentrations. Then we divided the waters into four water hardness categories according to the US Geological Survey classification[13] (0 to 60 mg/L as calcium carbonate is soft; 61 to 120 mg/L is moderately hard; 121 to 180 mg/L is hard; and more than 180 mg/L is very hard water).

pH determination. The pH of the water samples was measured using a pH-meter (Model 240, Corning). After calibration using standard buffer solutions we determined the pH of each sample.

Comparison to Dietary Reference Intakes (DRI). The National Academies of Sciences, Engineering, and Medicine provide DRIs for a wide range of nutrients for healthy individuals.[14] Among these are Recommended Dietary Allowances (RDA) for calcium and magnesium, and Adequate Intakes (AI) for fluoride, potassium and sodium. For our calculations of hypothetical mineral intake solely from bottled water, we assumed two individuals consuming either half a liter or two liters (approx. 68 fluid ounces) of the same bottled water per day.

Statistical analysis. Statistics for the minerals and pH were summarized for the water categories. For measurements below the limit of detection (F – 0.02 ppm; Ca – 0.1 ppm; Mg, Na, K – 0.01 ppm), we assumed a concentration of 0 ppm. We subjected a randomly chosen sample of ten bottled waters to repeat analyses. Data for all analytes were highly comparable to initial analyses. Quality assurance was performed by the last author.

RESULTS

The complete data set is available as supplementary data.

Type of bottled water and cost

We identified 92 different bottled waters. Table 2 presents a breakdown by category, continent and country of origin. The largest percentage (46%) of bottled waters were purified waters with

75% of all waters being from the USA. There was considerable overlap among categories as 11 waters could have been assigned to a second category based on their labeling. Four waters could not be assigned to any category due to their origin not being considered in the FDA nomenclature: two of these were ‘glacial waters’, the other two were ‘volcanic water’ and a ‘deep ocean water’, respectively. The cost per liter ranged between \$0.19 (purified water, USA) and \$3.99 (sparkling water, Germany) with an overall mean of \$1.64.

Fluoride

Figure 1 shows the fluoride concentration for all bottled waters. Generally, the fluoride concentration was very low in all water types, with only two waters containing more than 0.7 ppm (0.95 ppm; 1.22 ppm). Mean (± standard deviation) and median fluoride concentrations were 0.11 ± 0.19 ppm and 0.04 ppm, respectively. Sparkling bottled waters had the highest mean fluoride concentration (0.28 ppm) compared to purified waters which had the lowest mean fluoride concentration (0.02 ppm).

Calcium

The calcium concentrations are shown in Figure 2. Mean (± standard deviation) and median calcium concentrations were 26.9 ± 56.4 ppm and 5.2 ppm, respectively. Mineral waters contained the highest mean calcium concentration (102.9 ppm), although several sparkling waters contained more calcium. The mean calcium content was lower in the spring, artesian and purified bottled waters which contained an average of 31.6, 14.0 and 3.4 ppm, respectively.

Magnesium, Potassium and Sodium

Figure 3 shows the magnesium concentrations. Mean (± standard deviation) and median magnesium concentrations were 7.5 ± 14.6 ppm and 1.9 ppm, respectively. Sparkling, mineral and spring bottled waters contained similar mean magnesium concentrations which ranged between 19.7 and 11.5 ppm. For the other categories of bottled water, mean magnesium concentrations were lower than 8 ppm.

Potassium concentrations are shown in Figure 4. Mean (± standard deviation) and median potassium concentrations were 3.6 ± 7.2 ppm and 1.2 ppm, respectively. Mean potassium concentrations of all categories of bottled water were low at less than 6 ppm and ranging between 5.6 ppm for sparkling water and 1.3 ppm for spring water.

Figure 5 shows the sodium concentrations. Mean (± standard deviation) and median sodium concentrations were 11.1 ± 22.4 ppm and 2.9 ppm, respectively. Mineral waters displayed the highest mean sodium concentrations (26.5 ppm) and purified waters the lowest (4.9 ppm).

Water Hardness

Mean (± standard deviation) and median water hardness values were 97.9 ± 186.8 ppm and 24.6 ppm, respectively. Sparkling and mineral waters were the hardest waters with mean hardness values of 337 ppm and 324 ppm, respectively. All other categories were softer (spring – 126 ppm; artesian – 66 ppm; purified – 16 ppm; other – 11 ppm; all mean hardness). Thirteen waters (14%) were very hard, seven (8%) hard, 13 (14%) moderately hard and 59 (64%) soft.

pH

Mean (± standard deviation) and median pH values were 7.11 ± 1.39 and 7.12, respectively. Sparkling waters had the lowest mean pH (4.69), followed by mineral waters (5.90). All other categories of bottled water displayed a mean pH close to neutral, ranging between 7.68 to 7.24.

Labelling of mineral content and comparison to present data

The fluoride concentration or verbiage pertaining to it was displayed on the bottle label on only eight out of the 92 waters (9%). The actual fluoride concentration was displayed four times (0.000; 0.000; 0.112; 1.1 ppm), with the other four labels containing statements (“fluoride-free”, “free”, “no added fluoride”, “no fluoride”). There was good agreement between labelled fluoride concentrations and our measurements. Although we detected fluoride in all fluoride-free waters, concentrations were low and ranged between 0.004 – 0.043 ppm.

The calcium concentration or concentration range was displayed on the bottle label on 14 waters (15%), ranging from 5 to 390 ppm. When comparing to our measurements, we noted good agreement for 12 waters. One spring water (label 80 ppm Ca) had a Ca concentration below the limit of detection, whereas one artesian water displayed a similar discrepancy (label 94.4 ppm Ca vs. measured 32.9 ppm Ca).

The pH value or range was displayed on 34 waters (37%), varying from 6.2 to "9.5+". Out of these 34 waters, 31 had an alkaline pH (i.e., pH > 7.0). When using a margin of discrepancy of 0.5 pH units between the labelled pH and our measurements, we found lower than declared pH values in seven waters. A maximum discrepancy of 2.24 pH units (label pH 8.0 vs. measured pH 5.76) was noted for one spring water.

Comparison to Dietary Reference Intakes

Table 3 presents RDA and AI data for the analyzed elements for select populations and in comparison, to hypothetical contributions of the analyzed bottled waters.[21] Concerning fluoride, only one of the 92 bottled waters would provide the adequate intake needed for adults and only for the hypothetical consumption volume of two liters per day. Similar observations can be made for calcium and magnesium. For adults and assuming a hypothetical consumption volume of two liters per day, only two bottled waters would provide 50% of the RDI of calcium, whereas only one bottled water would provide 50% of the RDI of magnesium. Bottled waters do not contribute significantly to potassium or sodium intake and irrespective of the hypothetical consumption volumes considered presently.

DISCUSSION

A considerable segment of the U.S. population chooses bottled over tap water as their preferred choice of water intake, with ethnic and racial differences in consumption patterns.[4,15] Patients, often driven by polarized but false beliefs,[16] prefer bottled rather than tap water for a wide range of reasons, with the primary concern being the safety of tap water.[17,18,19] Additional reasons are the inferior taste and smell of tap water,[20] personality traits,[21] lifestyle[22] and convenience of bottled water in comparison to tap water from a community water system.[23]

The Centers for Disease Control and Prevention (CDC) has considered community water fluoridation (CWF) as one of 10 great public health achievements of the 20th century.[5] In 2016, 72.8% of the U.S. population on public water systems had access to water containing fluoride levels (0.7 ppm)[5] presently considered optimal for caries prevention.[24] However, efforts to increase access to CWF have stalled in recent years, with many States in fact seeing a decline in access to CWF.[5] Our study has shown that the vast majority of bottled waters are not a suitable substitute for fluoridated tap water as fluoride concentrations were suboptimal in all but two bottled waters (Fig. 1). This highlights that the availability of bottled water with an optimal fluoride concentration has not changed despite the increase in popularity of bottled water. It seems that the bottled water industry has thus far not considered fluoride a worthwhile mineral for marketing purposes. Especially alkaline waters (e.g. by adding a [bi]carbonate or hydroxide salt in addition to naturally alkaline waters) and those containing antioxidants (e.g. through supplementation with selenium ions), both with currently unproven health benefits, appear to be more favorable. In this context we must note that it is difficult for the public and professionals alike to discern which waters do contain fluoride at the point-of-purchase as the FDA does not presently require the fluoride concentration (or that of other minerals) to be displayed on the bottle label, unless fluoride was added to the water (e.g. nursery waters). Nonetheless, eight out of the 92 bottled waters we studied provided fluoride content information, thereby allowing for consumer choice.

To this date, only one observational study investigated whether the preferential consumption of bottled over tap water increases caries prevalence.[25] While the consumption of bottled water led to lower fluoride intakes, this study found no differences in caries incidence. It must be noted that this study was not designed to answer this research question and that only approximately 10% of study subjects consumed bottled water, highlighting the need for further studies on this topic.

For populations with access to CWF, the replacement of tap with bottled water would obviously lead to decreased fluoride exposure and could result in less anticaries protection for individuals or populations at high caries risk. However, according to NHANES 2007-2010 approx. one third of the US population uses some form of water treatment (at-home water filters and water treatment systems) to purify their drinking water.[15] Water filtration/purification systems vary considerably between point-of-entry systems (filters water before it enters the house), faucet and under sink filters, countertop, and pitcher type systems, as they utilize a wide range of approaches, including reverse osmosis, carbon filters, distillation and ion exchange. The use of a water filter can lead to a reduction in the effectiveness of CWF[26] as some forms of water purification will decrease fluoride concentrations and in the case of reverse osmosis systems almost completely eliminate fluoride. Hence, living in an area with CWF may not necessarily mean an individual will fully benefit from fluoride added to or naturally-occurring in their water supply. In this context, it should be noted that dental professionals should instruct their patients to use only water filters that do not remove fluoride, such as those with the ADA Seal of Acceptance.[27]

In addition to fluoride, a caries-protective effect of higher calcium concentrations in tap water has been shown in adolescents in Denmark.[28] Historically, a similar observation was made when water hardness (i.e., calcium and magnesium contents) was correlated with caries incidence in a United States-wide study from 1937, albeit naturally occurring fluoride was not considered.[29] The Denmark study showed that calcium can partially compensate for inadequate levels of fluoride in tap water – an aspect that has not been considered previously and should be taken into consideration in studies concerned with the effectiveness of CWF. Furthermore, two cross-sectional studies highlighted that dietary calcium intake is negatively related to tooth loss (due to caries)[30] and caries risk,[31] highlighting the oral relevance of calcium intake.

Similar to the fluoride data, our analyses have shown a wide range of calcium (Fig. 2) and magnesium concentrations (Fig. 3) in bottled waters and consequently also varying degrees of water hardness. A very recent study[32] on bottled waters concluded that some bottled water may be health-promoting as 15% (5/33) of the analyzed waters were very hard. Our more comprehensive study resulted in almost identical findings (14%; 13/92). Water hardness has been negatively related to risk of cardiovascular disease, although the evidence is controversial.[33] The consumption of hard water also has the potential to provide essential minerals, such as calcium and magnesium, which support critical metabolic functions and bone health.[14]

With our study we also wanted to investigate whether bottled water can provide meaningful contributions to intakes of fluoride, calcium, magnesium, potassium and sodium (table 3). Recommended Dietary Allowance (RDA) values form one of the sets of Daily Reference Intakes (DRI) which are used as a reference for the amount of minerals needed to support human health. A similar study to ours from 2001 found considerable discrepancy in mineral content not only between bottled waters but also, albeit to a lesser extent, among tap waters of the most populous cities in the USA.[8] Taking our study site, Indianapolis, IN, as an example, the most recent 2018 Drinking Water Report reported an average fluoride concentration of 0.75 ppm and a water hardness of 305 ppm.[34] Only very few bottled waters had a similar or higher fluoride concentration (2) or water hardness (11), with only one bottled water exhibiting both a higher fluoride concentration and hardness than tap water. Overall, only very few of the studied bottled waters can provide a significant contribution to the intakes of the studied minerals. It must be noted that we based our calculations on hypothetical consumption volumes of 0.5 or 2 L of any bottled water per day. We chose 0.5 L as it represents the mean bottled water intake by 19-50 year-olds.[4] We decided on 2 L for two reasons: a) as the EPA determined that “90 percent of the United States population ingests an amount of community water which is approximately less than or equal to the two liters/person/day”;[35] and b) to represent individuals consuming exclusively bottled water.[36-37] One study found that residents in the southern Pacific region, the southern region, and the southeast region of USA are consuming more bottled water than those who live in the Midwest.[38] This will affect the potential of bottled waters to provide meaningful contributions to mineral intake.

Several limitations need to be considered in the interpretation of our data. We only sampled the same brand and type of bottled water once rather than at every store it was available, thereby assuming no differences between production lots. Our study was geographically limited. Different brands of bottled waters are available in other parts of the USA. These would need to be studied to provide more generalizable data. We also assumed brand loyalty in our calculations and did not consider that individuals may drink different types of bottled water. Furthermore, the water market is constantly evolving as new waters are being introduced while others are being discontinued. We also did not consider flavored waters or otherwise enhanced waters, apart from alkaline waters, as well as other beverages consumed by the public. Lastly, there are other sources that contribute to fluoride intake, such as foods, beverages other than those studied presently, fluoride supplements, and fluoride-containing oral hygiene products. They would need to be studied to provide a comprehensive understanding of total fluoride intake.

CONCLUSIONS

The fluoride concentration in 90 of the 92 bottled waters we studied is insufficient for caries prevention. Only very few bottled waters can be considered health-promoting. However, some provide considerable contributions to calcium and magnesium intakes, albeit only when consumed in large quantities. The mineral content, and especially that of fluoride, of water – bottled or tap – should therefore be considered by dental professionals during their patients’ caries risk assessment. Patients with access to fluoridated water should be reminded about the benefits of community water fluoridation and to review the impact of any water filtration system used in their homes on fluoride levels in tap water. Dental professionals should know the fluoride levels in their local community water system, be knowledgeable about water filtration systems and their effects on fluoride levels, and know where their patients can have their water analyzed for fluoride. Dental professionals should also ask their patients about their preferred water intake (bottled or tap), and adjust treatment plans for caries prevention accordingly.

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Figure legends

Figure 1. Fluoride concentration in analyzed bottled waters by category. For each category, all individual data points (left) are shown next to box-whisker plots (right). Within each box-whisker plot, the filled circle highlights the mean, the horizontal line within the box displays the median, the box defines the 25th and 75th percentiles, the whiskers (vertical lines) define the 5th and 95th percentiles, whereas the triangles show the highest and lowest data points, respectively.

Figure 2. Calcium concentration in analyzed bottled waters by category (see figure 1 legend for further detail).

Figure 3. Magnesium concentration in analyzed bottled waters by category (see figure 1 legend for further detail).

Figure 4. Potassium concentration in analyzed bottled waters by category (see figure 1 legend for further detail).

Figure 5. Sodium concentration in analyzed bottled waters by category (see figure 1 legend for further detail).

Table 1. Bottled water nomenclature according to FDA § 165.110*

Category	Definition
Purified	water that has been produced by distillation, deionization, reverse osmosis, or other suitable processes
Spring	water derived from an underground formation from which water flows naturally to the surface of the earth; shall be collected only at the spring or through a bore hole tapping the underground formation feeding the spring. The location of the spring shall be identified.
Sparkling	water that, after treatment and possible replacement of carbon dioxide, contains the same amount of carbon dioxide from the source that it had at emergence from the source
Artesian	water from a well tapping a confined aquifer in which the water level stands at some height above the top of the aquifer
Mineral	water containing not less than 250 parts per million total dissolved solids, coming from a source tapped at one or more bore holes or springs, originating from a geologically and physically protected underground water source; shall be distinguished from other types of water by its constant level and relative proportions of minerals and trace elements at the point of emergence from the source, due account being taken of the cycles of natural fluctuations; no minerals may be added to this water.

*excerpts, for complete definitions see
https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?fr=165.110

Table 2. Bottled water categorization and origin

		North America			Europe					Oceania	
Category	n (%)	USA	Canada	Mexico	Italy	France	Germany	Iceland	Norway	New Zealand	Fiji
Purified	42 (46)	42									
Spring	25 (27)	17	1		1	2		4			
Sparkling[1]	12 (13)	5			5	1	1				
Artesian	7 (8)	3							1	2	1
Mineral[1]	2 (2)			1	1						
Other[2]	4 (4)	2	2								
Total	92 (100)	69	3	1	7	3	1	4	1	2	1

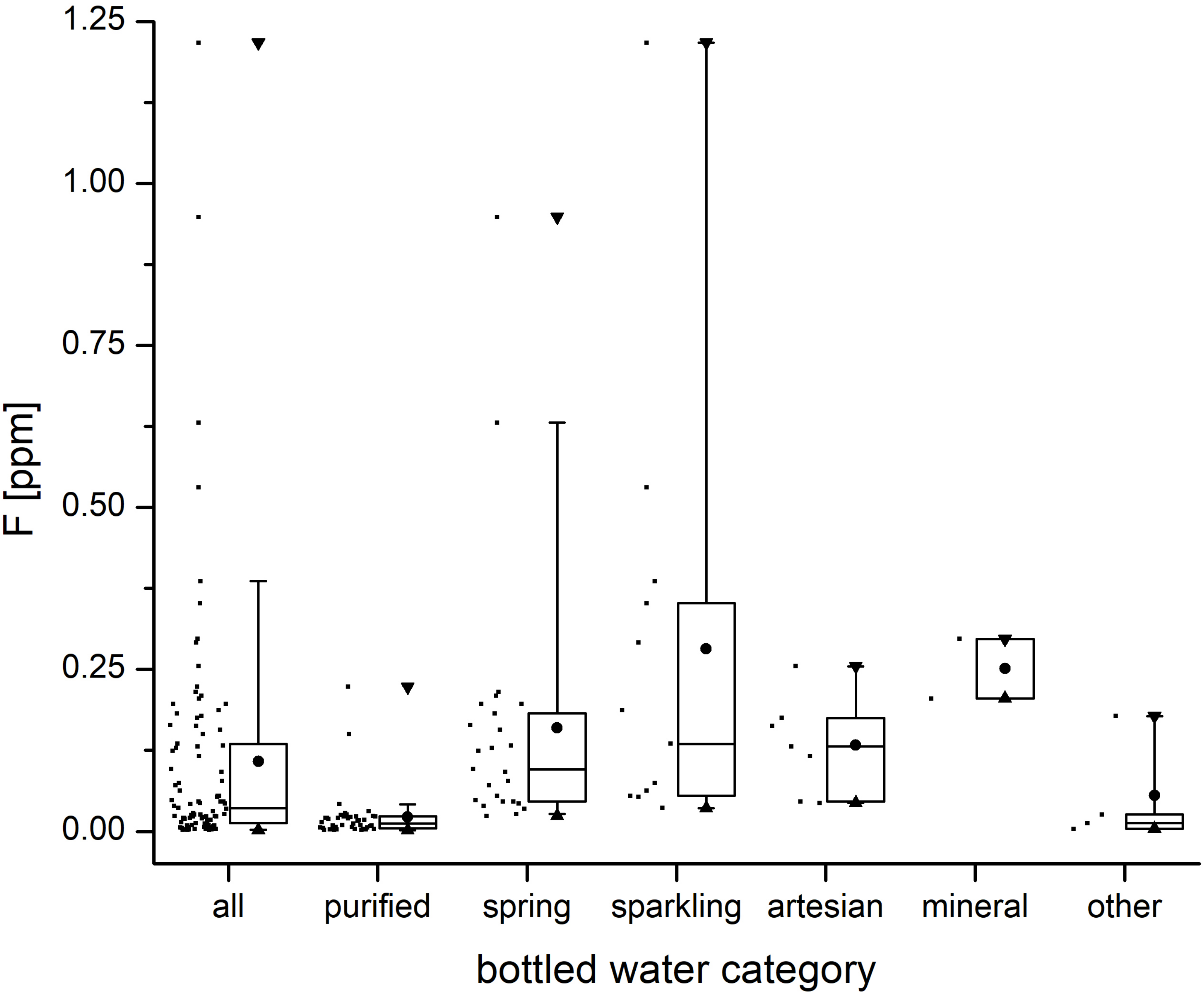
[1] Primary categorization; six sparkling waters were also mineral waters, three sparkling waters were also spring waters, one sparkling water was also an artesian water, whereas one mineral water was also sparkling.

[2] These bottled waters could not be assigned to any of the FDA-defined categories.

Table 3. Dietary reference intakes: Recommended dietary allowances (bold font) and adequate intakes (*) for select population subgroups vs. hypothetical[1] bottled water contributions

Group	Life stage	F [mg/d]	Ca [mg/d]	Mg [mg/d]	K [g/d]	Na [g/d]
Infants	0-6 mo	0.01*	200*	30*	0.4*	0.12*
	6-12 mo	0.5*	260*	75*	0.7*	0.37*
Children	1-3 y	0.7*	**700**	**80**	3.0*	1.0*
	4-8 y	1*	**1000**	**130**	3.8*	1.2*
Females	14-18 y	3*	**1300**	**360**	4.7*	1.5*
	31-50 y	3*	**1000**	**320**	4.7*	1.5*
	> 70 y	3*	**1200**	**320**	4.7*	1.2*
Males	14-18 y	3*	**1300**	**410**	4.7*	1.5*
	31-50 y	4*	**1000**	**420**	4.7*	1.5*
	> 70 y	4*	**1200**	**420**	4.7*	1.2*
	Bottled water contribution[1]					
	Min	0.00/0.00	0.00/0.00	0.00/0.00	0.00/0.00	0.00/0.00
	Max	0.61/2.43	180.2/720.6	53.0/212.0	0.02/0.09	0.05/0.22
	Mean	0.05/0.22	13.4/53.7	3.8/15.0	0.00/0.01	0.01/0.02
	Median	0.02/0.08	2.6/10.4	1.0/3.9	0.00/0.00	0.00/0.01
	Percentage of bottled waters providing x% of RDI/AI for 31-50 y female[1]					
	x = 10+	3.3/23.9	2.2/14.1	1.1/16.3	0.0/0.0	0.0/4.3
	x = 25+	0.0/5.4	0.0/5.4	0.0/4.3	0.0/0.0	0.0/0.0
	x = 50+	0.0/2.2	0.0/2.2	0.0/1.1	0.0/0.0	0.0/0.0
	x = 75+	0.0/1.1	0.0/0.0	0.0/0.0	0.0/0.0	0.0/0.0

[1] based on the consumption of 0.5/2 L of any analyzed bottled water per day.


1.25
1.00
0.75
0.50
0.25
0.00
F [ppm]
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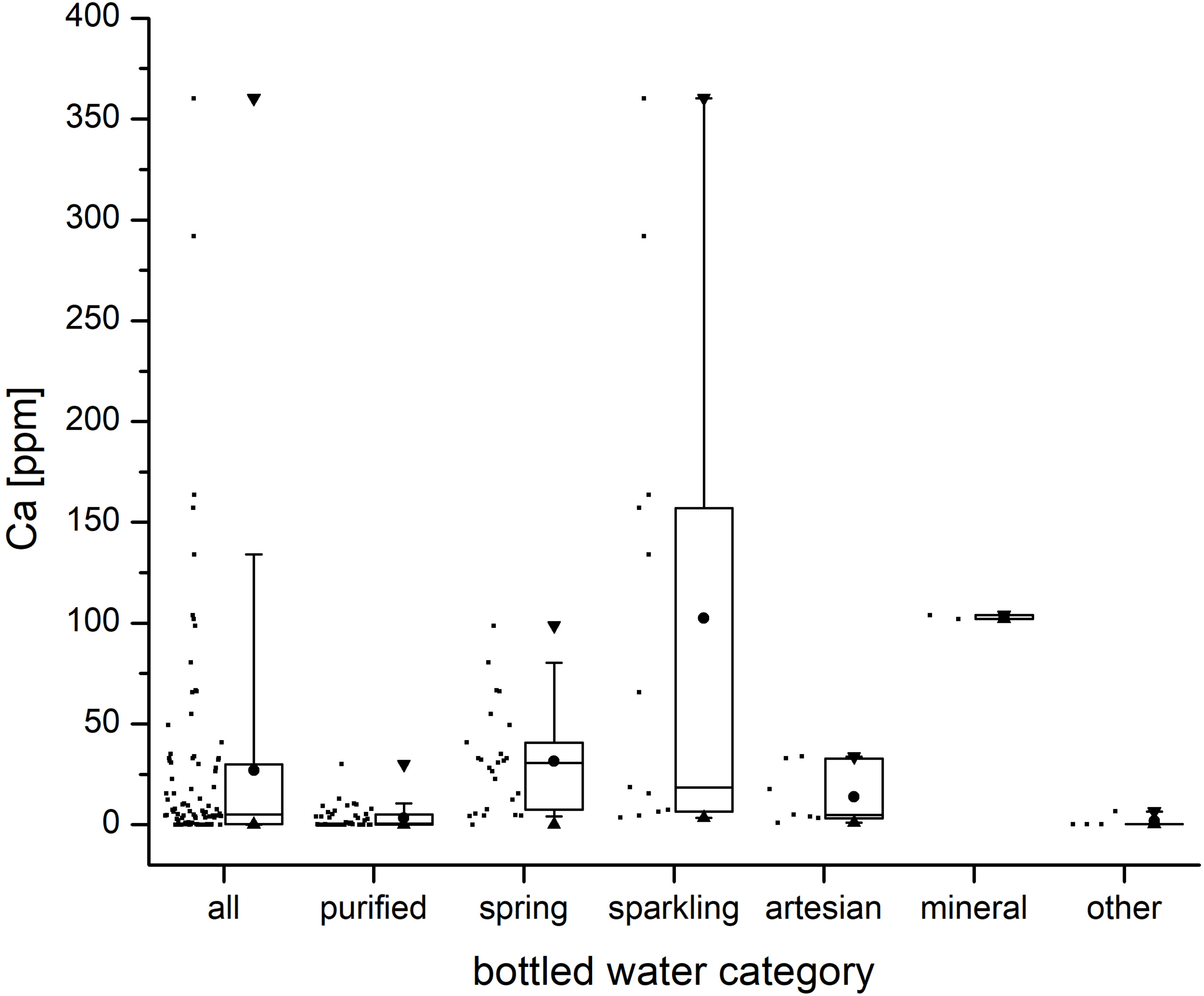
purified
spring
sparkling
artesian
mineral
other
bottled water category



Ca [ppm]
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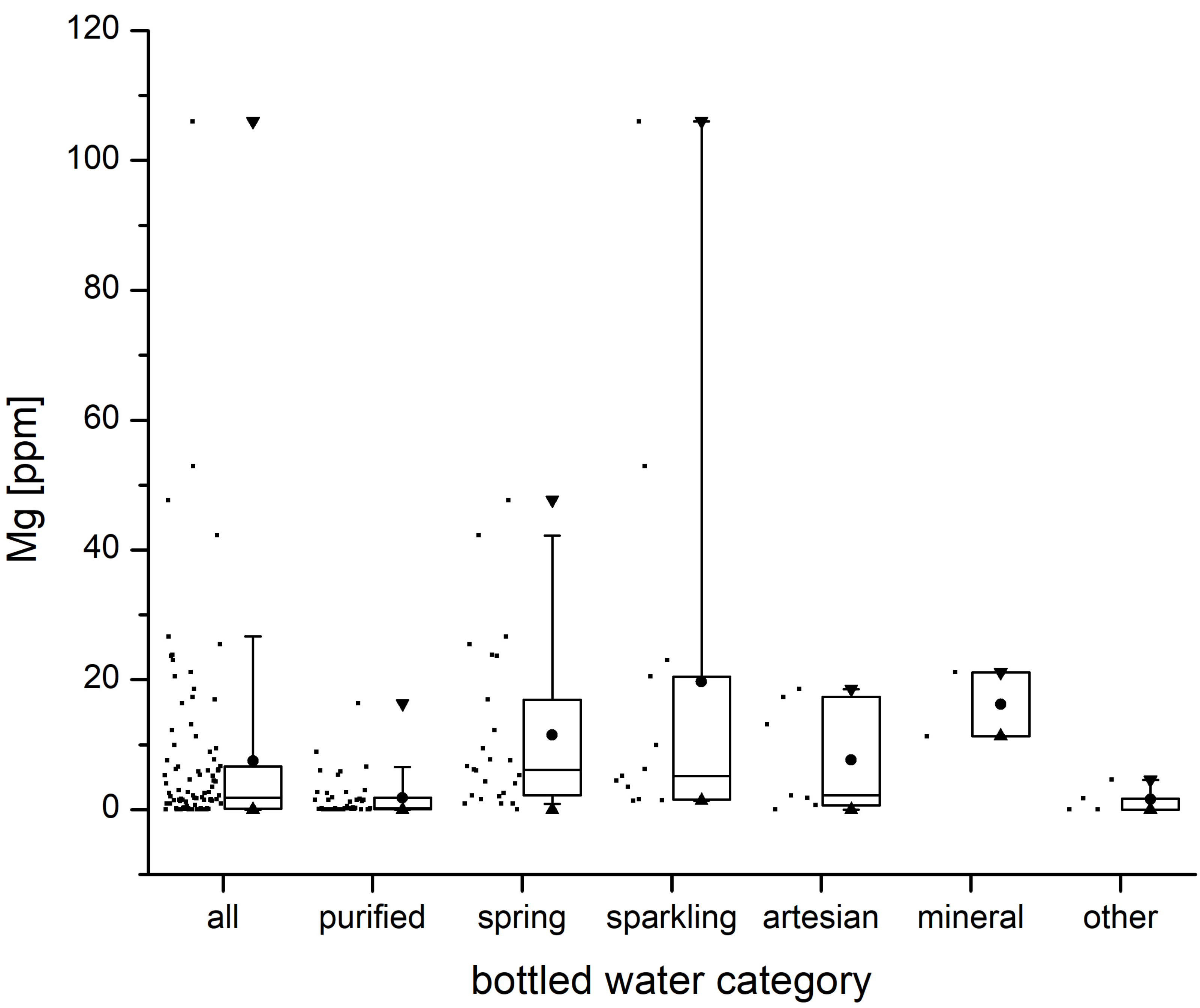
350
300
250
200
150
100
50
0
all
purified
spring
sparkling
artesian
mineral
other
bottled water category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100
80
60
40
20
0
Mg [ppm]
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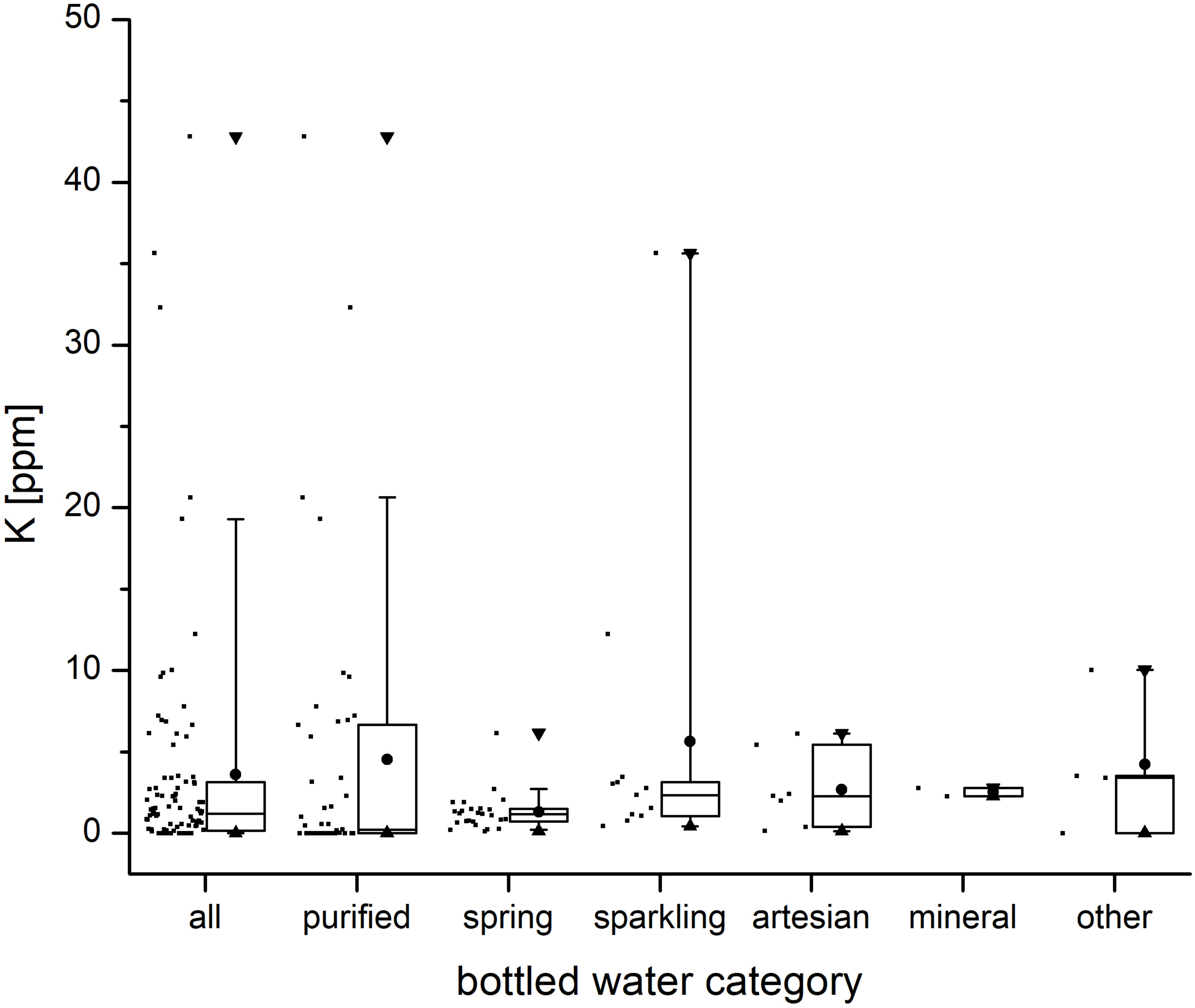
purified
spring
sparkling
artesian
mineral
other
bottled water category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40
30
20
10
0
K [ppm]
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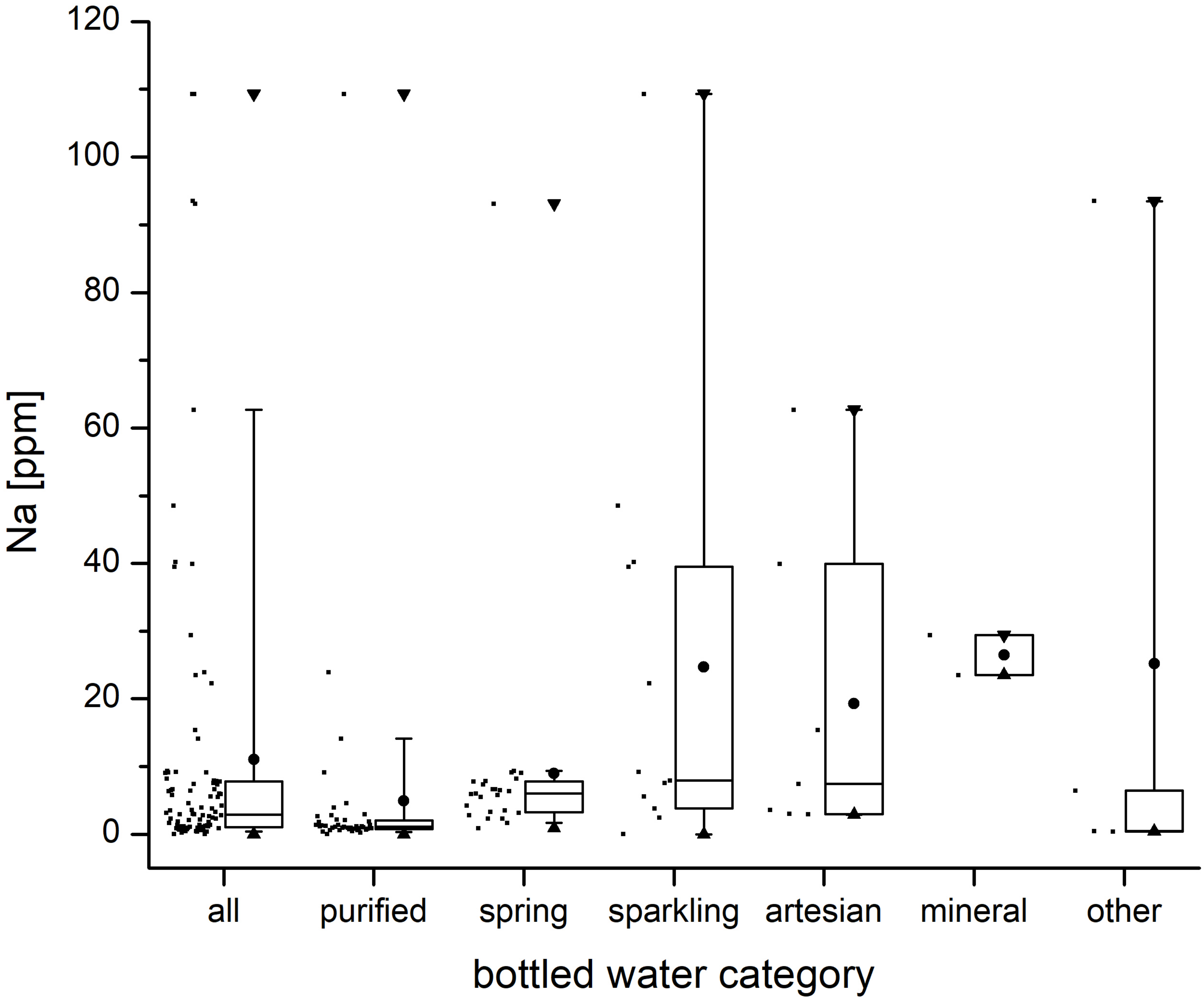
spring
sparkling
artesian
mineral
other
bottled water category



120
100
80
60
40
20
0
Na [ppm]
all
purified
spring
sparkling
artesian
mineral
other
bottled water category