

## Hydrogeological Assessment of the Mineral Composition of the Bottled Waters Available For Sale in Poland

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### ABSTRACT

The choice of bottled waters available for sale is large. The assessment of their mineral composition was based on the results of 120 natural waters and 46 mineral waters (in relation to the hydrogeological classification of water mineralization). Significant diversity was found in terms of the basic mineral composition, and in many cases also a wealth of microcompounds (e.g. fluorides, iodine, selenium), which have a positive effect on the human health. Both the deficiency and excess of the water consumed and the amount of contained ingredients have an influence on the human health. While choosing water, it is worth considering the volume of water consumed, the age and health of the consumer, season of year, activity, type of diet, taken dietary supplements, vitamins and medicines. The information on the label is sufficient to choose the water suited to the individual needs. The waters with high mineralization and/or with large concentrations of microcompounds should be used after medical consultations to determine their use: specify the area of application and recommended drinking amount and frequency.

**Keyword:** mineral composition of waters, bottled waters, calcium, magnesium, fluorides

### INTRODUCTION

The potential consumer has no influence on the chemical composition of the water supplied by the water supply companies to the houses. Its quality in physicochemical, bacteriological and radioactive aspects is controlled by water supply companies, adapting to the requirements of sanitary regulations defining the limit values for individual water components, established by the Minister of Health [Journal of Laws of 2017, item 2294]. The information on the water composition is public and water companies often place the water analysis on their websites, e.g. for Warsaw [<https://www.mpwik.com.pl/view/jakosc-wody>]. When buying bottled waters, consumers have a choice not only regarding the gas content (still, low-saturated with CO<sub>2</sub>, medium-saturated with CO<sub>2</sub>, high-saturated with CO<sub>2</sub>), but also water mineralization (expressing the amount of mineral dissolved in it) and the content of individual minerals. The choice of water available for sale is wide: natural mineral waters, natural spring

waters and table waters. The human demand for water depends on many factors, including diet, ambient temperature and activity of life. The recommended consumption of water for children up to 10 years is 1750 ml/day, and with age increases to 2500 ml/day for adults [Jarosz, 2017]. Both water shortage and excess are detrimental for the human health.

While choosing water, it is worth taking into account the age of the consumer, season of year, physical effort, volume of consumed water, type of diet, dietary supplements, vitamins and medicines, health condition and possible medical recommendations (especially in hypertension, heart disease and diabetes). The deficiency of ingredients such as calcium or magnesium adversely affects the human health. By drinking water with the appropriate composition, the deficiency of the missing ingredient can be supplemented at least partially. However, it should be remembered that the systematic supply of excess minerals by daily consumption of highly mineralized waters can lead to their dangerous accumulation and to

the development of kidney stones. As a result, all these factors make the choice of water seem difficult; hence, the chemical composition of the water being purchased is not taken into account, and the price governs the purchase of a given water.

The purpose of the article was to analyze the mineral components in bottled waters from a hydrogeological point of view, to facilitate the proper selection of water in relation to the needs according to age, physical activity, season of the year, and state of health. In pursuit of the goal, the information from the labels of bottled water available in Poland was analyzed and compared with the applicable legal provisions of bottled water and the hydrogeological knowledge.

## MATERIAL AND METHODS

The hydrogeological analysis applies only to those waters that are produced and bottled in Poland. The waters that are available in stores in Poland but were imported from abroad were not considered. The ionic composition of the water was adopted from the data on the bottle label. No additional laboratory water tests were performed. The labels date from the period 2003–2019, so some of the waters may be withdrawn from sale. The flavored waters (e.g. lemon, apple, strawberry) available for sale are not discussed here. Although they look like water (they are colorless) and should rather be treated as drinks (they contain sugar and aromas).

The producer of bottled water is required to provide the following on the label of the bottle: information on the place of intake and production of water, the content of characteristic mineral components in the water and the total content of dissolved mineral components [Journal of Laws, of 2011, No. 85, item 466]. The second condition is met in all waters considered, while the first condition, i.e. the content of individual components, has not always been observed throughout the analyzed period of 2003–2019.

Due to the fact that not all mineralization of water was given on label, mineralization was calculated as sum of the ions content dissolved in water. The difference between the values provided by the producers on the label and the calculated mineralization was small and does not affect the further interpretation of the results. In the cases when the water with the same trade name had a different ionic composition (change

in water chemistry in the different years), all data were given (subsequent numbers were added for identification). This situation was found in the following cases: Aqua Minerale, Bieszczady Zdrój (ujęcie POL-1), Czantoria, Dobrovit, Kinga Pienińska, Kropla Beskidu, Kryniczanka, Kuracjusz Beskidzki, Mineral, MuszynA Cechini (Józef), Muszyna Minerale (odwiert P-III), Nałęczowianka, Odyseus (ujęcie Perła Sudeców), Perła Krynicy (odwiert K-6), Piwniczanka, Świtezianka, Wieniecka – Zdrój, Woda źródłana Marino Zdrój, Zdroje Piwniczna i Złoty Potok. Many bottles of water did not have the data on the ionic composition of the water on the label. For example: Amita, Aqua Virgo, Aquamontis (ujęcie Kryształ nr 2), ArcA North, Bonaqua, Deep (ujęcie Kryształ nr 2), Saguaro (ujęcie nr 2), Siti (ujęcie Kryształ nr 2), Słowianka (zakład nr 2), Ustronianka magnesiowa (ujęcie nr 2), Woda źródłana Kropla 6, Źródło Tymbark i Żywiecki kryształ (ujęcie nr 1).

Natural mineral waters, natural spring waters and table waters are available for sale. According to the definitions given in the Regulation of the Minister of Health [Journal of Laws of 2004, No. 120, item 1256], both natural mineral water and natural spring water come from documented groundwater resources and are of adequate chemical and microbiological quality. They are distinguished by the fact that the natural mineral water is characterized by a stable mineral composition and properties of physiological significance, causing a beneficial effect on the human health, while the natural spring water is characterized by the fact that the properties and mineral composition should not differ from the water intended for human consumption, specified in the provisions on the collective water supply. The table water is a mixture of the spring water, natural mineral water or mineral salts, containing at least one of the components having physiological significance (e.g. sodium, magnesium, calcium, chlorides, sulfates, bicarbonates). Mineralization of these waters is divided into three groups: 1) very low mineralized (total content of mineral salts below 50 mg/dm<sup>3</sup>), 2) low mineralized (total content of mineral salts below 500 mg/dm<sup>3</sup>), 3) highly mineralized (the total content of mineral salts exceeds 1500 mg/dm<sup>3</sup>) [Journal of Laws of 2001, No. 85, item 466].

The above-mentioned names of water and their classification in relation to mineralization were not used in hydrogeology. According to the definition of mineral waters used by

hydrogeologists, mineral water is defined as water containing at least 1000 mg/dm<sup>3</sup> (or more) of dissolved solid compounds (Słownik hydrogeologiczny, 2002). The waters with lower mineralization than 1000 mg/dm<sup>3</sup> are called natural waters. In this aspect, bottled water is considered below. From a hydrogeological point of view, not all water, commonly known as “mineral” water is actually mineral. The interpretation includes the results of 120 analyses of ordinary waters and 46 analyses of mineral waters. The interpretation was based on the classification proposed by hydrogeologists.

## RESULTS AND DISCUSSION

In bottled waters, dissolved ions called macromineral components (major ions) by hydrogeologists, are very common in large concentrations. These include: calcium, magnesium, sodium, potassium, bicarbonate, sulfates and chlorides. Micro-mineral components (minor ions), such as fluorine, are less common and in small concentrations. The total content of these components cause the mineralization of water.

### Characteristics of natural bottled waters

The analyzed natural waters (with mineralization not exceeding 1000 mg / dm<sup>3</sup>) show a large diversity in terms of mineralization (Figure 1). In the classification of waters proposed by Macioszczyk ed. [2006], there are: 1) ultra fresh water with 100 mg/dm<sup>3</sup> mineralization, 2) fresh water with 100–500 mg/dm<sup>3</sup> mineralization and 3) acratopegic water – 500–1000 mg/dm<sup>3</sup>. The analyzed natural bottled waters most often reach mineralization from 200 to 900 mg/dm<sup>3</sup> and are classified as fresh and acratopegic water. Only the mineralization of Kasztelańska Woda slightly exceeding 100 mg/dm<sup>3</sup>, which makes it close to ultra-fresh waters.

Natural waters show a considerable diversity in the ionic composition (Figure 2). Major cations (calcium, magnesium, sodium and potassium) occur in different concentrations and in different proportions to each other.

Calcium usually reaches the highest concentrations, except for the following waters: Augustowianka, Durabo, Jantar, Java, Kuracjusz Beskidzki and Mazowszanka, in which sodium dominates over calcium (Figure 2). Among the main anions (bicarbonates, sulfates and chlorides), generally the bicarbonate ions prevail over other anions. Only in the case of Jaworowy Zdrój water, the concentration of sulfates prevails over bicarbonates (Figure 2). High concentrations of sulfate (with the dominance of bicarbonate) have water: Rabka Zdrój (220 mg/dm<sup>3</sup>) and MagneVita (210 mg / dm<sup>3</sup>). These concentrations approaching the limit value for drinking water, which is 250 mg/dm<sup>3</sup> [Journal of Laws of 2017, Item 2294]. Chlorides are not the dominant anion of the analyzed waters. The highest concentrations of this anion, achieved around 200 mg/dm<sup>3</sup> was stated in the following waters: Jantar (212.7 mg/dm<sup>3</sup>), Augustowianka (187.9 mg/dm<sup>3</sup>) and Maksymiliana (166 mg/dm<sup>3</sup>).

A component that is quite common but found in natural groundwater in low concentrations is fluoride ion. In the waters where this component has been found, it occurs in the concentrations from 0.02 mg/dm<sup>3</sup> (Żywiec Zdrój woda – Pilsko intake in Jeleśnia near Żywiec) to 1.4 mg/dm<sup>3</sup> (Aqua Minerale, Augustowianka). The maximum content is close to the limit value for drinking water, according to which the permissible content of fluoride in drinking water may not exceed 1.5 mg/l [Journal of Laws of 2017, item 2294]. Given the fluoride content, all analyzed normal waters can be drunk by children. At concentrations of 1.5 mg/dm<sup>3</sup>, the label should state “Contains more than 1.5 mg/l of fluoride. It should not

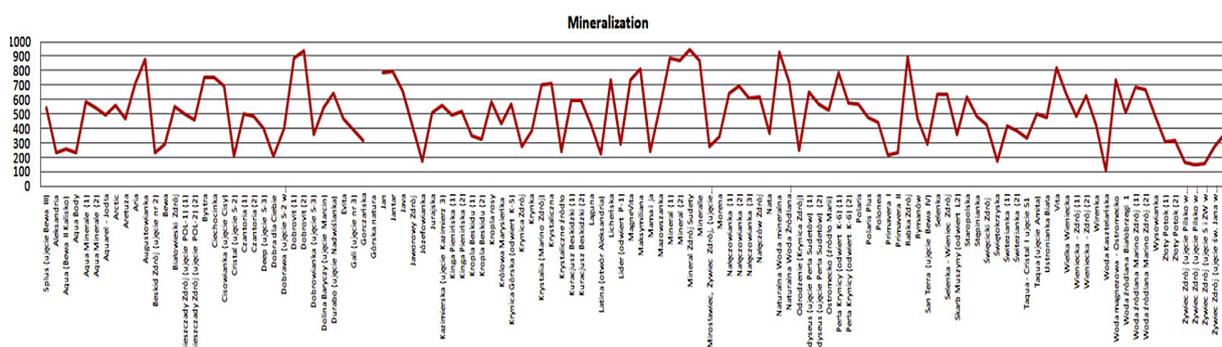


Figure 1. Mineralization of natural bottled waters.

be regularly consumed by children under 7 years of age” [Journal of Laws of 2011, No. , Item 466]. For example, the water from the water supply network in Warsaw (on December 2019), depending on the place, contained from 0.06 mg/dm<sup>3</sup> of fluoride (Northern Water Intake) through 0.11 mg/dm<sup>3</sup> (Central Water Intake FILTRY) to 0.14 mg/dm<sup>3</sup> (Central Water Intake PRAGA) [https://www.mpwik.com.pl/view/jakosc-wody].

Considering the chemical composition of natural water in terms of the extreme content of the selected ions, a large variety can be seen (Table 1). The contents of some compounds differ by several orders of magnitude, which gives the consumer a large selection in terms of his age, season, physical activity or medical recommendations. The sodium concentrations is from about 1 mg/dm<sup>3</sup> (Górska Natura) to 254 mg/dm<sup>3</sup> (Java), the calcium content ranges from 10 mg/dm<sup>3</sup> (Java) to over 200 mg/dm<sup>3</sup> (Ciechocinka). Similar diversity also applies to other ions.

### Characteristics of mineral bottled waters

In the case of mineral waters (with mineralization exceeding 1000 mg/dm<sup>3</sup>) the highest amount of dissolved ingredients indicating the highest mineralization was found in the Zuber

water (26924.78 mg/dm<sup>3</sup>) (Figure 3). High mineralization was also found in water: Szczawa II (18038.6 mg/dm<sup>3</sup>), Szczawa I (17133.9 mg/dm<sup>3</sup>) and Franciszek (14814.3 mg/dm<sup>3</sup>). Many bottled mineral waters come from the Muszyna region (south of Poland). Their mineralization ranges from ~ 1400 mg/dm<sup>3</sup> to ~ 2500 mg/dm<sup>3</sup>, depending on the location of the intake.

In mineral waters, the calcium and bicarbonate ions predominate, with varying concentrations (from 187.9 mg/dm<sup>3</sup> – Perła Swoszowic to 18549.47 mg/dm<sup>3</sup> – Zuber) (Table 2). The analysis shows that in particular cases, a significant content in the group of cations is sodium (Dziedzilla, Franciszek, Hanna, Henryk, Krystynka, Szczawa I, Szczawa II, Zuber), while among the anions – chlorides (Dziedzilla, Franciszek, Hanna, Henryk, Krystynka, Szczawa I, Szczawa II, Zuber) or sulfates (Perła Swoszowic) (Figure 4). It can be seen that in mineral waters, the high sodium contents coexist with the high chloride contents. The water with this composition should be avoided by the people with hypertension, heart disease and diabetes. In the case of Krystynka water, chlorides predominate among anions, and in the case of the Perła Swoszowic water, sulfates prevail over anions.

Bottled mineral waters are often characterized by a very large amount of dissolved

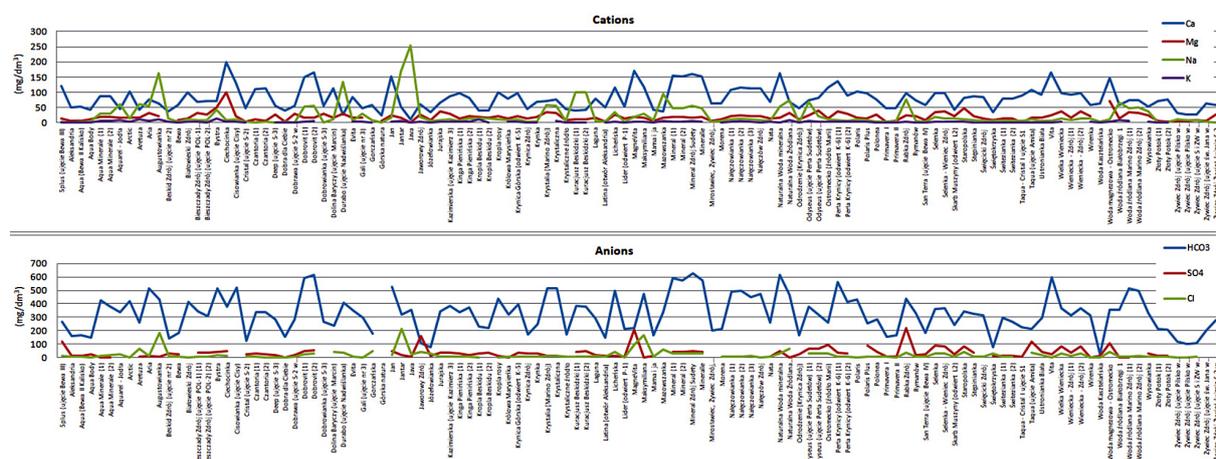


Figure 2. Major ions of natural bottled waters.

Table 1. Extreme contents of selected ions and mineralization of natural bottled waters.

| Contents | Ca <sup>2+</sup>      | Mg <sup>2+</sup>      | Na <sup>+</sup>          | K <sup>+</sup>                         | HCO <sub>3</sub> <sup>-</sup>            | SO <sub>4</sub> <sup>2-</sup>           | Cl <sup>-</sup> | F <sup>-</sup>                         | mineralization                    |
|----------|-----------------------|-----------------------|--------------------------|--|--|---|-----------------|--|-----------------------------------|
|          | mg/dm <sup>3</sup>    |                       |                          |  |  |   |                 |  |                                   |
| min.     | 10<br>Java            | 0,37<br>Java          | 1,05<br>Górska<br>Natura | 0,11<br>Naturalna<br>Woda<br>Mineralna | 23,6<br>Woda<br>źródłana<br>Kasztelańska | 0,02<br>Woda<br>źródłana<br>Białobrzegi | 2<br>Vita       | 0                                      | 109,26<br>Woda<br>Kasztelańska    |
| max.     | 200,22<br>Ciechocinka | 100,02<br>Ciechocinka | 254<br>Java              | 13,5<br>Bystra                         | 625<br>Mineral Zdrój<br>Sudety           | 220<br>Rabka Zdrój                      | 212,7<br>Jantar | 1,4<br>Aqua Minerale,<br>Augustowianka | 943,38<br>Mineral Zdrój<br>Sudety |

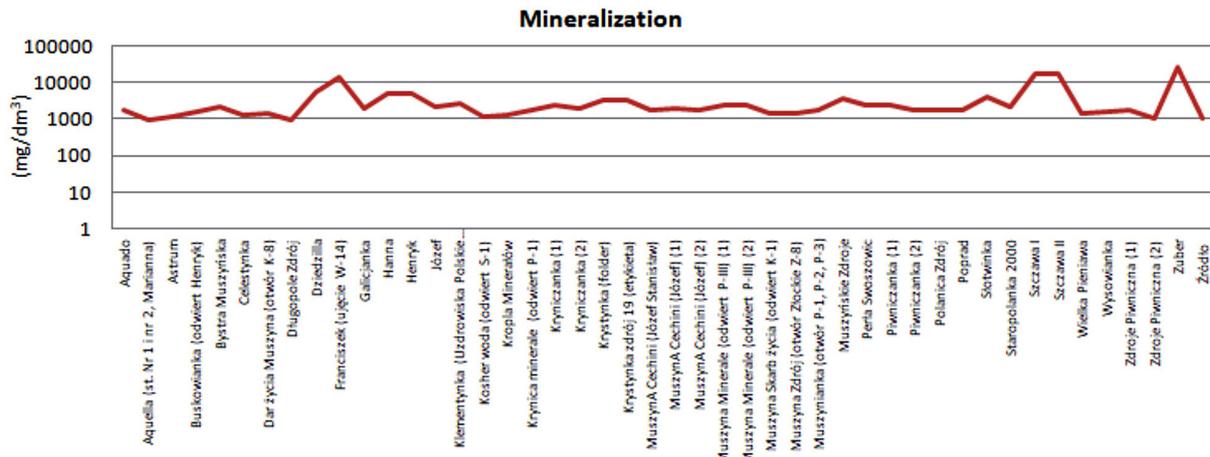


Figure 3. Mineralization of mineral bottled waters.

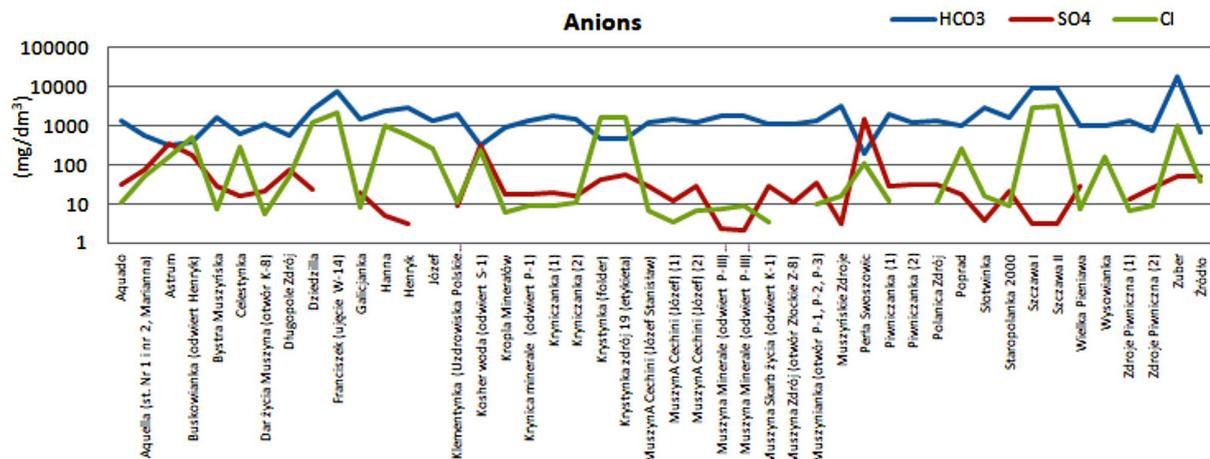
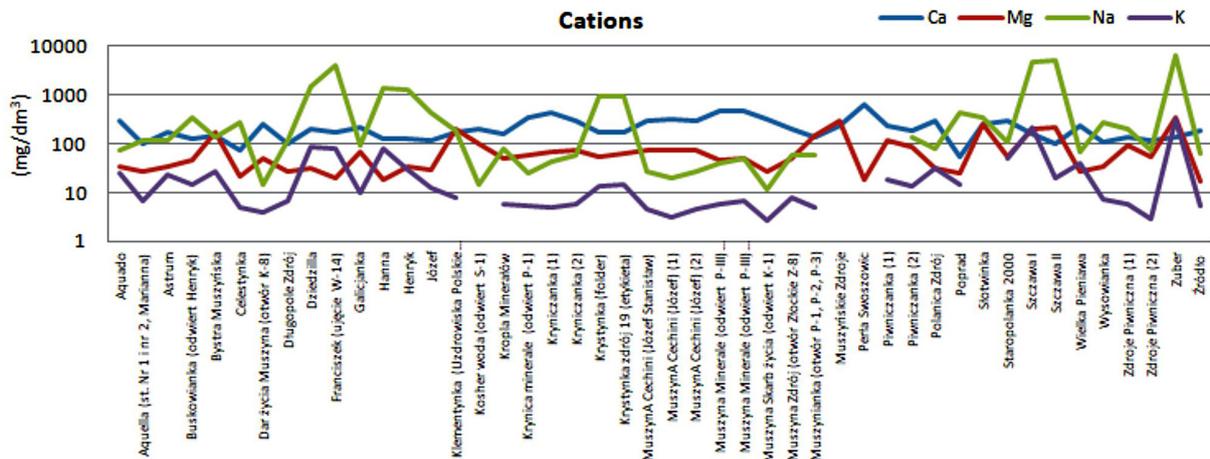


Figure 4. Major ions of mineral bottled waters.

minerals (high mineralization), which may give the water a characteristic taste, e.g. salty (at high concentrations of chloride and sodium). Insofar as everyone can drink natural water, drinking mineral water should result from the specific therapeutic indications and take place under

medical supervision. This applies especially to the waters with high mineralization and / or containing microcomponents. They affect the health conditions when they used internally (drinking, inhalation) or externally (baths). Owing to which many of them obtained the status of therapeutic

**Table 2.** Extreme contents of selected ions and mineralization of mineral bottled waters.

| Contents | Ca <sup>2+</sup>            | Mg <sup>2+</sup> | Na <sup>+</sup>                    | K <sup>+</sup>                 | HCO <sub>3</sub> <sup>-</sup> | SO <sub>4</sub> <sup>2-</sup> | Cl <sup>-</sup>                | F <sup>-</sup>             | mineralization    |
|----------|-----------------------------|------------------|------------------------------------|--------------------------------|-------------------------------|-------------------------------|--------------------------------|----------------------------|-------------------|
|          | mg/dm <sup>3</sup>          |                  |                                    |                                |                               |                               |                                |                            |                   |
| min.     | 55,31<br>Poprad             | 17,3<br>Źródło   | 11,33<br>Muszyna<br>Skarb<br>Źycia | 2,66<br>Muszyna<br>Skarb Źycia | 187,9<br>Perła<br>Swoszowic   | 2,21<br>Muszyna<br>Minerale   | 3,55<br>Muszyna<br>Skarb Źycia | 0,11<br>Perła<br>Swoszowic | 1000<br>Aquella   |
| max.     | 651,3<br>Perła<br>Swoszowic | 331,32<br>Zuber  | 649,5<br>Zuber                     | 320<br>Zuber                   | 18549,47<br>Zuber             | 1425<br>Perła<br>Swoszowic    | 3267<br>Szczawa II             | 1,5<br>Aquella             | 26924,78<br>Zuber |

waters and sanatoriums and spas are based on them. These include the waters of Franciszek, Szczawa I, Szczawa II and Zuber. As was mentioned above, their mineralization is very high (Figure 4), and in addition there are other micro-components: iodine, bromine, lithium and iron (Table 3). The therapeutic properties of these waters should be used with caution, preferably after medical consultations.

### Criteria for choosing bottled water

While choosing water on one's own, it is worth following the recommended and sufficient doses to consume selected minerals in terms of their influence on the human health (Table 4). There are compounds recommended for consumption (e.g. Ca, Mg, F, Se, J, Fe, Mn) and those whose quantity should be limited (Na, K).

For infants, both the recommended and sufficient doses of the above-mentioned compounds are lower. The water intended for the preparation of baby food should be chosen with particular care. It should not contain more sodium and chloride than 20 mg/dm<sup>3</sup>, and fluoride less than 0.7 mg/dm<sup>3</sup>. Attention should also be paid to the nitrogen compounds, the amount of which in the form of nitrite should not exceed 0.02 mg/dm<sup>3</sup>, and the amount of nitrate 10 mg/dm<sup>3</sup> [Szajewska et al., 2014, Journal of Laws of 2010 r. No 21, item 105, Journal of Laws of 2011, No 85, item 466].

Both macro- and microcompounds are very important for the human health. Calcium builds bones and teeth, and its best-known advantage is the prevention of osteoporosis. Calcium is also responsible for the proper functioning of the heart and vascular system and for the proper activity

**Table 3.** Specific compounds in bottled mineral waters.

| Specific compounds | Water  |
|--------------------|--|
| Se                 | Muszyna ACechini (Józef), Muszyna Źródło (otwór Źłockie Z-8), Perła Swoszowic  |
| J                  | Celestynka, Dziedzilla, Franciszek (ujęcie W-14), Henryk, Józef, Klementynka (Uzdrowiska Polskie S.A.), Krystynka, Krystynka Źródło, Poprad, Szczawa I, Szczawa II, Wysowianka, Zuber            |
| Br                 | Franciszek (ujęcie W-14), Krystynka, Krystynka Źródło, Zuber   |
| Li                 | Dziedzilla, Franciszek (ujęcie W-14), Hanna, Klementynka (Uzdrowiska Polskie S.A.), Kryniczanka, Krystynka, Muszyna ACechini (Józef), Perła Swoszowic, Piwniczanka, Szczawa I, Szczawa II, Zuber |
| Sr                 | Krystynka  |
| Fe                 | Dziedzilla, Hanna, Klementynka (Uzdrowiska Polskie S.A.), Krystynka, Krystynka Źródło, Perła Swoszowic, Piwniczanka, Szczawa I, Szczawa II, Zuber  |
| Mn                 | Klementynka (Uzdrowiska Polskie S.A.), Krystynka   |

**Table 4.** Recommended and sufficient doses of selected compounds (depending on age) [Jarosz ed., 2017].

| Compounds<br>mg/day                   | Recommended dose |         |         |                   |                      |       |                      | Sufficient dose |                |
|---------------------------------------|------------------|---------|---------|-------------------|----------------------|-------|----------------------|-----------------|----------------|
|                                       | Ca               | Mg      | F       | Se                | J                    | Fe    | Mn                   | Na              | K              |
| Children<br>1–9 years                 | 700–1000         | 80–130  | 0,7–1,2 | 20–30             | 90–100               | 7–10  | 1,2–1,5              | 750–1200        | 800–1800       |
| Children<br>teenagers,<br>10–18 years | 1300             | 240–410 | 2–3     | 40–55             | 120–150              | 10–15 | 1,6–2,2              | 1300–1500       | 2400–3500      |
| Women<br>19 – >75 years               | 1000–1200        | 310–320 | 3       | 55<br>60*<br>70** | 150<br>220*<br>290** | 10–18 | 1,8<br>2,0*<br>2,6** | 1200–1500       | 3500<br>4000** |
| Man<br>19 – >75 years                 | 100–1200         | 400–420 | 4       | 55                | 150                  | 10    | 2,3                  | 1200–1500       | 3500           |

\*pregnancy \*\* lactation

of the muscular-nervous system (including conduction of nerve stimuli) [Jarosz ed., 2017]. Due to the support of metabolism, it is recommended preventively and therapeutically in the problems with obesity and diabetes. Limiting the consumption of the water containing high concentration of calcium is recommended only for kidney diseases. Magnesium is the second element supporting the work of the musculoskeletal system. An important role in the human organism is to regulate the work of the heart, nerve conduction, muscle contractility (calcium antagonist), and blood pressure regulation. It is recommended as an ingredient preventing heart attacks and atherosclerosis. Magnesium is known to be a stress reliever. Sodium helps in the proper water and electrolyte balance, in the acid-base regulation of the organism, increases the secretion of digestive juices. The people with hypertension, heart disease and diabetes are recommended to drink the water with a low sodium content.

Potassium controls the muscle contractions and work, acid-base balance, stimulates insulin secretion, and affects the cell osmotic pressure. The bicarbonates found in water neutralize the gastric acids, favorably affecting the peracid (they help maintain acid balance in the stomach). The waters containing this ion lower the blood sugar and urine. The sulphate-containing waters increase the secretion of the bile (accelerate metabolism). They are helpful in the treatment of the urinary tract inflammation and catarrhal

conditions. Chlorides are an important component of the gastric acid, they are involved in digestive processes. A chloride deficiency interferes with maintaining adequate hydration and osmotic pressure. Fluoride is an important ingredient in the human diet and has many benefits as long as it is delivered to the organism in the proper dose. Both its insufficiency and excess are harmful to health. A deficiency of this component increases the susceptibility to caries, while an excess causes discoloration. In addition, the fluoride accumulating in the bones can block the absorption of magnesium by the organism, cause allergies, changes in the thyroid function and other enzyme systems, damage the immune system and lead to excessive irritability. Its excess in children causes chronic fatigue and concentration problems [<https://dziecisawazne.pl/fluor-pomaga-czy-szkodzi/>].

The variety of bottled waters, in relation to the components described above, is large (Figure 5) and this applies to the natural and mineral waters. The Java water with a low calcium content and a very high sodium content stands out from the composition of natural waters. Against the mineral waters, the Zuber water with a similar ratio of calcium to sodium, the Krystynka water with a large proportion of chlorides and the Perła Swoszowic water with a large proportion of sulfates, stand out.

In accordance with the applicable law [Journal of Laws of 2011, No. 85, item 466] on the bottle label there should be information on

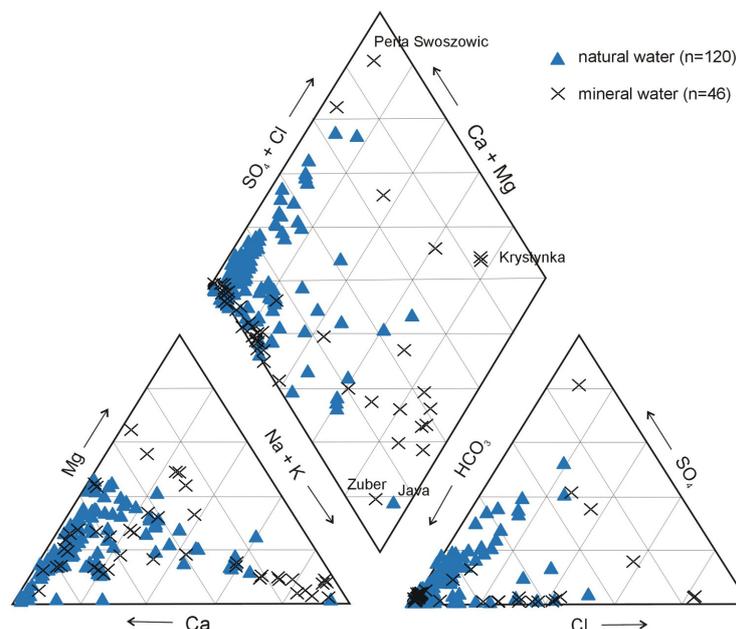


Figure 5. Comparison of ion distribution in natural and mineral bottled waters.

exceeding the relevant (given in the above Act) values of individual ingredients in bottled waters (Table 5). This applies to calcium, magnesium, sodium, bicarbonate, sulfates, chlorides, fluorides and iron. The analysis shows that the selection of waters in this respect is large. Similarly, the label

should state that it is suitable for a low-sodium diet when the content of this component does not exceed 20 mg/l. There is a very large selection of waters with this composition on sale (Table 5).

The pH of the water is rarely given on the bottle label. The available studies (41 water samples

**Table 5.** Bottled waters with exceeded values of individual components.

| No. | Information                    | Criteria according to [Dz. U. Nr 85 z 2011 r., poz. 466] | Examples of bottled waters   |
|-----|--------------------------------|--|--|
| 1   | Contains calcium               | $Ca^{2+} > 150$ mg/l                                     | Ciechocinka, Dobrovit, Jan, MagneVita, Mineral, Mineral Zdrój Sudety, Minerale, Naturalna Woda mineralna, Vita, Aquado, Astrum, Dar życia Muszyna (otwór K-8), Dziedzilla, Franciszek (ujęcie W-14), Galicjanka, Klementynka (Uzdrowiska Polskie S.A.), Kosher woda (odwiert S-1), Kropla Mineralów, Krynica minerale (odwiert P-1), Krynica, Krystynka, MuszynACEchini (Józef Stanisław), MuszynACEchini (Józef), Muszyna Minerale (odwiert P-III), Muszyna Skarb życia (odwiert K-1), Muszyna Zdrój (otwór Złockie Z-8), Muszyńskie Zdroje, Perła Swoszowic, Piwniczanka, Polanica Zdrój, Słotwinka, Staropolanka 2000, Szczawa I, Wielka Pieniawa, Źródło   |
| 2   | Contains magnesium             | $Mg^{2+} > 50$ mg/l                                      | Ciechocinka, Woda magnezowa – Ostromecko, Bystra Muszyńska, Dar życia Muszyna (otwór K-8), Galicjanka, Klementynka (Uzdrowiska Polskie S.A.), Kosher woda (odwiert S-1), Kropla Mineralów, Krynica minerale (odwiert P-1), Krynica, Krystynka, MuszynACEchini (Józef Stanisław), MuszynACEchini (Józef), Muszyna Minerale (odwiert P-III), Muszyna Zdrój (otwór Złockie Z-8), Muszynianka (otwór P-1, P-2, P-3), Muszyńskie Zdroje, Piwniczanka, Słotwinka, Staropolanka 2000, Szczawa I, Szczawa II, Zdroje Piwniczna, Zuber  |
| 3   | Contains sodium                | $Na^+ > 200$ mg/l  | Java, Buskowińska (odwiert Henryk), Celestynka, Dziedzilla, Franciszek (ujęcie W-14), Hanna, Henryk, Józef, Krystynka, Poprad, Słotwinka, Szczawa I, Szczawa II, Wysowianka, Zuber   |
| 4   | Suitable for a low-sodium diet | $Na^+ < 20$ mg/l   | 5plus (ujęcie Bewa III), Aleksandria, Aqua (Bewa II Kalisko), Aqua Body, Arctic, Beskid Zdrój (ujęcie nr 2), Bewa, Białowieski Zdrój, Bieszczady Zdrój (ujęcie POL-1), Bieszczady Zdrój (ujęcie POL-2), Ciechocinka, Cisowianka (ujęcie Cisy), Cristal (ujęcie S-2), Czantoria, Deep (ujęcie S-3), Dobra dla Ciebie, Dobrawa (ujęcie S-2 w Rzeniszowie), Dobrowianka (ujęcie S-3), Dolina Baryczy (ujęcie Marcin), Evita, Gorceńska, Górska natura, Jan, Jaworowy Zdrój, Józefowianka, Jurajska, Kazimierska (ujęcie Kazimierz 3), Kinga Pienińska, Kropla Beskidu, Kropla rosy, Królowa Marysieńka, Krynica Górska (odwiert K-5), Krynica Zdrój, Krynka, Krystaliczne źródło, Laguna, Latina (otwór Aleksandria), Lider (odwiert P-1), MagneVita, Mama i ja, Mirosławiec, Żywiec Zdrój, (ujęcie św. Jana), Morena, Nałęczowianka, Nałęczów Zdrój, Nata, Odrodzenie (Krynica Zdrój), Ostromecko (źródło Marii), Perła Krynicy (odwiert K-6), Polaris, Polaris Plus, Polonea, Primavera, Rymanów, San Terra (ujęcie Bewa IV), Selenka, Selenka – Wieniec Zdrój, Skarb Muszyny (odwiert L2), Staropolska, Stępinianka, Święcicki Zdrój, Świętokrzyska, Świtezianka, Taqua – Cristal I ujęcie S1, Taqua (ujęcie Amita), Ustronianka Biała, Vita, Wielka Wieniecka, Wieniecka – Zdrój, Wirenka, Woda Kasztelańska, Woda magnezowa – Ostromecko, Złoty Potok, Żywiec Zdrój (ujęcie Pilsko w Jelesni k. Żywca), Żywiec Zdrój (ujęcie S i ZW w Cięcinie k. Żywca), Żywiec Zdrój (ujęcie św. Jana w Mirosławcu), Żywiec Zdrój Żywiol (ujęcie S-2 w Rzeniszowie), Dar życia Muszyna (otwór K-8), Kosher woda (odwiert S-1), Muszyna Skarb życia (odwiert K-1) |
| 5   | Contains bicarbonate           | $HCO_3^- > 600$ mg/l                                     | Dobrovit, Mineral Zdrój Sudety, Naturalna Woda mineralna, Aquado, Bystra Muszyńska, Celestynka, Dar życia Muszyna (otwór K-8), Dziedzilla, Franciszek (ujęcie W-14), Galicjanka, Hanna, Henryk, Józef, Kropla Mineralów, Krynica minerale (odwiert P-1), Krynica, MuszynACEchini (Józef), MuszynACEchini (Stanisław), Muszyna Minerale (odwiert P-III), Muszyna Skarb życia (odwiert K-1), Muszyna Zdrój (otwór Złockie Z-8), Muszynianka (otwór P-1, P-2, P-3), Muszyńskie Zdroje, Piwniczanka, Polanica Zdrój, Poprad, Słotwinka, Staropolanka 2000, Szczawa I, Szczawa II, Wielka Pieniawa, Wysowianka, Zdroje Piwniczna, Zuber, Źródło   |
| 6   | Contains sulfates              | $SO_4^{2-} > 200$ mg/l                                   | MagneVita, Rabka Zdrój, Astrum, Kosher woda (odwiert S-1), Perła Swoszowic   |
| 7   | Contains chlorides             | $Cl^- > 200$ mg/l  | Jantar, Buskowińska (odwiert Henryk), Celestynka, Dziedzilla, Franciszek (ujęcie W-14), Hanna, Henryk, Józef, Kosher woda (odwiert S-1), Krystynka, Poprad, Szczawa I, Szczawa II, Zuber   |
| 8   | Contains fluorides             | $F^- > 1$ mg/l   | Aqua Minerale, Augustowianka, Durabo (ujęcie Nadwiślanka), Aquella (st. Nr 1 i nr 2, Marianna), Długopole Zdrój, Krystynka   |
| 9   | Contains iron                  | $Fe^{2+} > 1$ mg/l                                       | Dziedzilla, Hanna, Klementynka (Uzdrowiska Polskie S.A.), Perła Swoszowic,   |

analyzed) show that the pH ranges from 5.18 to 8.14 [Porowski et al., 2018]. The bottled waters with a pH exceeding pH 9 are also available [<https://www.woda-alkaliczna.pl/ranking/alkalicznosc-wody-mineralnej>]. The Java water producers offer high pH water up to 9.2. However, most producers offer waters with a neutral pH. With the preference of consuming the acid-forming products, which include: meat and its products, eggs and cereal products, it should be borne in mind that during their metabolism, acidification of the organism may occur. It is balanced by the consumption of base-forming products: vegetables, fruits, milk and dairy products. Drinking the water with an appropriate pH in relation to the diet supports the acid-base balance of our organism.

## CONCLUSIONS

The review showed that there is a large number of bottled waters with various mineral compositions. The classifications of mineralization used in science differ slightly from the classifications referring to bottled waters, but it comes down to different names, which does not affect the quality of the water. Table water does not have to be of natural origin. It is a mixture of waters (spring, natural or mineral water) or mineral salts, which causes the loss of its natural composition. It is also worth remembering that the so-called flavored waters (e.g. lemon, apple, strawberry) only look like water and due to the added sugar and aromas, they should be treated as drinks.

Reliable information is provided on the labels of bottled water and allows for individual selection of water in relation to the age of the person and his health, season, physical activity and the amount of water consumed.

The positive effects of microcomponents found in waters (fluorides, iodides, bromides, selenium) during drinking or inhalation are the basis of therapeutic methods in spas and sanatoriums in which rehabilitation is based on their skillful use. The use of therapeutic properties of waters rich in these components should result from medical indications and be carried out under the supervision of the experts, despite the fact that they water are widely available for sale. Similar attention is required when using the waters with very high mineralization, often accompanied by high concentrations of sodium, an ingredient not recommended for people with hypertension. Due

to the diverse ionic composition of water and the predisposition of the human organism, not every type of water will be suitable for everyone. The people who are susceptible to stress are recommended the water with an increased content of magnesium, and people with the stomach problems are recommended the water with a properly selected concentrations of bicarbonate. It is worth remembering that with hard work on hot days, drinking the water containing a higher amount of ingredients than usual is recommended.

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