



Improvement of health status of population of the Slovak Republic through drinking water re-carbonization

PROJECT NAME:

Improvement of health status of population of the Slovak Republic through drinking water re-carbonization (LIFE 17 ENV/SK/000036)

Acronym **LIFE – WATER and HEALTH**

Coordinating Beneficiary:

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Recommendation of the proposal for the inclusion of calcium and magnesium among the regulated parameters in the Drinking Water Directive and national regulations for drinking water

The concentration of calcium and magnesium in surface and ground water used for drinking purposes varies depending on the geological environment. In the carbonate geological environment, the concentration of calcium (Ca) and magnesium (Mg) is relatively high. In the silicate geological environment (granitoids, crystalline schists and volcanic rocks) the concentration of Ca and Mg is very low. These silicates geological environment, in which water with a low Ca and Mg concentration is formed, represents approximately 30% of the territory in European countries. Hundreds of different studies carried out over the last 60-70 years indicate that the low concentration of Ca ($< 30 \text{ mg} \cdot \text{l}^{-1}$) and Mg ($< 10 \text{ mg} \cdot \text{l}^{-1}$) in drinking water has a negative effect on human health. People who are supplied with drinking water with low water hardness (insufficient Ca and Mg concentration) have a life expectancy five years shorter than people supplied with hard drinking water. They have a significantly higher incidence/mortality for all major causes of death, including cardiovascular, oncological diseases or diabetes mellitus and other serious diagnosis (e.g. Rapant et al., 2021).

The influence of Ca and Mg concentration in drinking water on the incidence/mortality of cardiovascular diseases was confirmed in the scientific literature by several meta-analyses (Catling et al., 2005; Jiang et al., 2016; Gianfredi et al., 2017). Despite this information, most EU countries do not regulate the minimum desirable concentration of Ca and Mg at all or just as recommended guideline values (Kožišek, 2020).

Although the low concentration of Mg is not so dominant risk factor of mortality on cardiovascular diseases as smoking, obesity and lack of exercise, its relative risk of this disease is up to 20%. With the current very frequent incidence of this disease means 20% or even just 10% such numerous deaths that it exceeds many times all other deaths caused by other components of drinking water in the EU.

Currently, the question of adequate concentration of Ca and Mg in drinking water is very important. Not only in European countries, but also in the world, as more and more drinking water (including bottled drinking water) is produced by desalination of seawater. The concentration of Ca and Mg in this water is really very low, often only at the level of less than 1 mg of Ca and Mg. It is necessary to remineralize this type of water from health reasons.

The relationship between the concentration of Ca and Mg in drinking water and their impact on human health has been monitored in the Slovak Republic in the last 12 years in three European projects financed under the LIFE program:

1. LIFE 10 ENV/SK/000086 (GEOHEALTH)
2. LIFE 12 ENV/SK/000094 (LIFE FOR KRUPINA)
3. LIFE 17 ENV/SK/000036 (LIFE – WATER and HEALTH).

GEOHEALTH project confirmed that concentration of Ca and Mg in drinking water represent the most important elements on human health and their influence is more than one hundred times higher than the concentration of potentially toxic elements or nitrates (Rapant et al., 2017).

In the project LIFE FOR KRUPINA we confirmed that the low concentration of Ca and Mg in drinking water has a negative impact on the cardiovascular system of the residents. This effect was confirmed by measuring the arterial stiffness and the subsequent determination of arterial age, which was significantly higher (more unfavourable) in residents supplied with "soft" drinking water, i.e. water with low Ca/Mg contents (Rapant et al., 2019).

In the project LIFE – WATER and HEALTH we confirmed that the arterial stiffness and the arterial age of residents which they were supplied with "soft" drinking water significantly improves their overall health and quality of life was improved when their drinking water was enriched with Ca and Mg. The arterial age of people who started drinking remineralized drinking water was improved by an average of 10 years. It was also confirmed that the health status of people supplied with drinking water with a higher concentration of Ca and Mg is better than of the residents who are drinking water with a low concentration of Ca and Mg. Not one of the diagnoses listed in the International Classification of Diseases was found, in which the mortality rate of residents supplied with "hard" drinking water would be higher than that of residents supplied with "soft" drinking water. On the opposite, in the case of "hard" drinking water, the mortality rate was always lower than in the case of "soft" water (Cvečková and Rapant, 2022).

Based on the research in the world literature and the results achieved within the LIFE projects, we suggest that concentration of Ca and Mg should be included as regulated parameters in drinking water, at least as the parameters with recommended limit values.

From the research of the scientific literature and the achieved results by the above-mentioned European projects, we can propose the following values for regulation of Ca, Mg and water hardness.

Proposal for Ca and Mg concentrations (limit values) in drinking water

Parameter	Minimal concentration	Optimal (recommended) values
Ca [mg . l ⁻¹]	> 30	50 – 100
Mg [mg . l ⁻¹]	> 10	25 – 50
Water hardness /Σ Ca+Mg/ [mmol . l ⁻¹]	> 1.2	2.0 – 4.5

It is important that the content of Ca and Mg in the water is mainly in the form of hydrogen carbonates and not in chlorides, sulphates or nitrates forms.

With these proposed optimal values of Ca, Mg and water hardness, people in Slovakia and other European countries live the longest and have the lowest incidence/mortality from cardiovascular, oncological and other diseases.

In case of bottled drinking water (where there are no technological restrictions like scaling of pipes, water heaters, washing machines, dishwashers, etc.), we suggest that the Ca concentration should be > 50 mg. l⁻¹ and Mg > 30 mg. l⁻¹.

Due to the risk of low concentration of Mg, Ca and other essential elements in drinking water, it is necessary in the future, when the new toxic chemical elements with only a hypothetical risk on health will be regulated, which cannot be removed other than by using ultra membranes (which would also reduce the concentration of magnesium and other beneficial elements), to carefully consider all the pros and cons, so that the removal of the hypothetical toxic risk does not simultaneously increase the proven risk related to the insufficient concentration of magnesium and calcium in the water.

Literature:

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