

Towards Health Maintenance: Silica and Calcium Supplementation of Drinking Water

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insufficiency in the daily food and drink on the individual, family and community. Owing to its great importance to the human health, silica should be listed in the dietary reference intake tables in KSA. However, any supplementation must be done after discussion with physicians.

Introduction

Minerals are regarded as the single most important group of nutrients. Minerals constitute approximately 4% of the total body mass (Wilson, 2012). Minerals are classified into trace and major minerals. The human body needs less than 100 mg/day of the trace minerals, while it requires more than 100 mg/day of the major minerals. Minerals participate in and facilitate the vast majority of the body functions; they activate the muscles and nerves, facilitate the processes of digestion, energy production and healing. Minerals play an important role in the formation of teeth and bones, maintenance of the ordinary heart rhythm, contraction of the muscles, transmission across the neurons and acid-base balance and regulation of the cellular metabolism (Soetan *et al.*, 2010). Trace minerals often work in pairs or triplets.

Minerals are classified into macro-minerals (e.g. calcium, sodium and phosphorus) and trace minerals (e.g. iron,

Abstract

The present study estimates the levels of silicon and calcium in different water brands available in Al Qurayyat, Al Jouf Region, northern KSA. The study surveyed 17 domestic and two imported drinking bottled water brands, a purified (desalinated) ground water brand, 6 household and 7 local drinking water brands. Silicon and calcium varied markedly among water brands. The domestic bottled drinking water brands had no silica. In contrast, silica attained relatively high levels in the imported water brands. On the other hand, calcium was encountered, but to varying degrees, in all water brands. All the drinking water brands comply with the requirements of SASO, GCS and WHO. Calcium level in the local drinking water was higher than that in the domestic bottled drinking water. The present study recommends the supplementation of the drinking water brands with sufficient amounts of calcium and silicon to compensate for the deficiency of these two vital elements in the daily intake of food. The present study also recommends the launching of an intensive awareness campaign about the importance of the mineral nutrients in the promotion and maintenance of the human health. The study discussed the role of calcium and silicon in human well being and the deleterious impacts resulting from their

and relaxation, maintain regular heart beat, transmission of the nerve impulses, flow of information among brain cells, and helps maintain of the proper body fluid pH, etc. (Weaver and Heany, 2006; Roza, 2007). Calcium leaves bones when the acidity of blood is increased and this induces an abnormality called acidosis.

Silica is regarded as one of the most important mineral nutrients in the earth. Silica is present in soil, plants and water. It has a broad spectrum of applications in the industrial field and medications (Martin, 2007). Silica is distributed in all the body organs (Martin, 2007) and is a key element in the formation of collagen. Silicic acid refers to the soluble forms of silica that are abundant in the groundwater. Silica is absorbed by human in the form of orthosilicic acid. The latter is found in liver, bones, aorta, kidney and tendons.

The human body accommodates approximately 7 grams of silica. That far exceeds the levels of some key mineral nutrients, e.g. iron. The reserves of Si in the body are consumed as the human gets older. This weakens bones and nails, makes the skin dry and wrinkled and the hair dull. The collagen fibers should be maintained underneath the skin to create elasticity and flourishing. Silica plays an important role with respect to the human immunity.

Al Qurayyat is an attractive geographical region in the northern part of Saudi Arabia. The city accommodates approximately 360000 people belonging to several nationalities and therefore exhibit different feeding habits. However, to the best of our knowledge, the majority of the calcium and silicon-rich foods are not common in Al Qurayyat population's diet. The present study aims to raise the awareness about the importance of the

zinc, silicon and boron). Each macro-mineral or a group of minerals is concerned with a specific function(s) in the body: calcium is known as the structural element; magnesium is the bright and shining mineral; sodium, the volatility and the solvent mineral; potassium, a heart and a solvent mineral; chlorine, a cleanser; sulfur, a fiery cleansing and joining mineral; phosphorus, the most fiery energy mineral. Similarly, the trace minerals have specific functions inside the human body: Iron is referred to as the oxygen carrier and an energy mineral; copper, the emotional mineral and intuitive mineral; chromium, a development and a blood sugar mineral; selenium, a critical spiritual mineral; lithium is the brain protection mineral; silicon, an important nutrient for the skin and bones (Soetan *et al.*, 2010).

Unlike many nutrients, minerals cannot be synthesized inside the human body. The sea salt helps our bodies to obtain some of these mineral nutrients. Most of the beneficial minerals are refined out of common table salt. Moreover, refined table salt contains added toxic metals such as aluminum. Other mineral-rich foods are organic vegetables, especially root vegetables. Lieberman *et al.* (2007) reported that nuts, grains and seeds, meat and fish are good mineral sources. Regardless their high content of sugars, water and fiber, the fruits are poor sources of minerals.

Calcium is the most common mineral in our bodies. The body stores approximately 99 % of its calcium in teeth and bones. The remainder is distributed throughout the body in the intercellular fluids, blood and muscular tissues. Calcium helps maintain strong teeth and bones, prevent bone loss accompanied to osteoporosis, control muscle contraction

Results

Figure 1 compares the levels of calcium between the imported and domestic bottled drinking water brands supplied to the population in Al Qurayyat. Figure (1) shows that Evian water is supplemented with relatively high amount of calcium (80 mg/l). Also, Figure (1) illustrates that Volvic water brand was supplemented with a relatively small amount of calcium. This essential mineral nutrient attained moderate values in Nestle and Hilwa water brands (36 mg/l and 23.5 mg/l, respectively). Other domestic bottled water brands exhibited lower calcium levels (from less than 0 to 20 mg/l).

Figure 2 compares the levels of silica between imported bottled water brands, household water brands, local drinking water brands and purified water brand supplied to the population in Al Qurayyat. From figure (2), it is obvious that the imported bottled drinking water brands are much more supplemented with silica than the domestic brands. It is also obvious that the vast majority of the household water brands, the local drinking water brands and the purified (desalinated) water brand contain negligible amounts of silica (Figure 2).

Figure 3 shows the concentration of silica in different household water brands supplied to the population in Al Qurayyat. From figure (3), it can be noticed that there is a marked variability in the levels of silica among different household water brands. The level of silica in the household water varied between 0.8 and 6 mg/l. This seems likely to reflect a corresponding diversity of the household water sources in this geographical area.

Silica levels in different local drinking water brands supplied to the population in Al Qurayyat are illustrated in

supplementation of the drinking water with mineral nutrients, particularly silicon, the magic, forgotten mineral nutrient that promotes health and strengthen bones and teeth. The question to be answered: Does Al Qurayyat's population obtains sufficient dietary intakes of calcium and silicon?

Materials and Methods

A total of 36 water brands were surveyed for two highly important mineral nutrients, namely calcium and silicon. The studied water brands comprised 17 brands of the domestic and two brands of the imported bottled water, a purified (desalinated) ground water produced by Al Qurayyat water treatment plant, 6 brands of the household water and 7 brands of the local drinking water. The domestic bottled water brands included Al Qassim, Hilwa, Taiba, Hana, Nuva, Hijra, Dala, Aquafina, Arwa, Naba, Al Ghazal, Nestle, Marwa, Fayha and Yanabe Al Qassim. The imported bottled water brands included Volvic and Evian that are produced and bottled in France. The local drinking water brands were collected from the following areas: sample A, from Al Azizzia; sample B, from Al Gomrok; samples C and D, from Al Matar region; samples E and F from Al Naseem region; G and H, from farms nearby Al Qurayyat; sample I, from the laboratories of the Community College in Al Qurayyat and J, from an old tank.

Following the instructions of the laboratory of Al Qurayyat Water Treatment Plant, the water samples were collected in sterilized, clean and dry bottles to assure the accuracy of the results. Each water brand was represented by three randomly selected specimens. At the laboratory, water samples were analyzed for calcium and silicon using spectrophotometer.

cornea, cartilage, ligaments and gut (Di Lullo *et al.* 2002). The collagen fibers give the connective tissues strength and flexibility. The lack of collagen accelerates the appearance incidence of the aging symptoms that include joint pain, osteoporosis, atrophy of tissues, folded skin, abnormal digestion, tooth health problems (Rondeau *et al.*, 2009).

According to Ittekkot *et al.* (2006), silicon lowers bad cholesterol and blood pressure, helps maintain the skin, hair, nails and joints healthy, combats age spots, detoxifies heavy metals, prevents kidney stones and normalizes circulation (Ittekkot *et al.*, 2006). In this respect, silicon-rich water brands may be considered in the elderly care programs, whenever they do not interfere with any prescribed medications. Silicon acts as a normal diuretic agent. It also counteracts dry skin, improves digestion, helps prevent kidney stones and stimulates the cell formation. It facilitates greater calcium absorption leading to stronger bones, helps remove plaque accumulated on the walls of the blood vessels and stimulates tissue regeneration essential to wound healing.

Silicon maintains the human health and energy and maximizes the health potential. Silicon occurs in the bones, cartilages, hair, blood vessels, skin, teeth, tendons and nails. The body is full of youth whatever more silicon in relation to calcium present is. Recent studies have revealed that the Si/Ca ratio is an indicator of youth (e.g. Sommers, 2007). According to Guyonnet *et al.* (2007), silica seems to have a role in delaying Alzheimer. Silica is efficient in the detoxification of heavy metal poisoning in human body, e.g. Aluminum. Aluminum causes negative impacts on the nerve cells particularly of the brain. Together with the brain tissue calcification, aluminum causes

figure 4. All the local drinking water brands are poor in silicon. The highest level was 3.0 mg/l. The majority of these water brands attain silica levels below 1.0 mg/l.

Figure 5 illustrates the content of calcium in different household water brands supplied to the population in Al Qurayyat. Extremely high calcium level (200 mg/l) could be recognized for the water brand E. Moreover, relatively high calcium levels could be also noticed for the household water brands A, B and C. In contrast, other water brands were poor in calcium.

Calcium levels in different local drinking water brands supplied to the population in Al Qurayyat are illustrated in figure 6. Except for relatively high calcium level recorded for the water brands I and J (42 mg/l and 80 mg/l, respectively), all the local drinking water brands attained calcium levels below 20 mg/l (Figure 6). This indicates that calcium level in the local drinking water is higher than that in the domestic bottled drinking water.

Discussion

Humans are born with plentiful amounts of silica within their tissues and cells. As the human gets older, the natural reserves of the collagen fibers gradually decline to the level where the skin condition markedly deteriorated and shows signs of aging. Silica combats common signs of aging by improving the elasticity of skin and enhances the formation of collagen fibers. Therefore, silica is highly important in maintaining the youthfulness of the skin. Synthesis of collagen in the human body is dependent on silicon (Di Lullo *et al.* 2002). Collagen fibers are common in fibrous tissues, for example bones, skin, tendons, blood vessels, fibrocartilages between adjacent vertebrae,

markedly low values to obviously high levels. Calcium level in the local drinking water was higher than that in the domestic bottled drinking water. All the domestic and imported bottled drinking water brands, the local drinking water brands and the household water brands in the present study were below the requirements of the Saudi Standards, Metrology and Quality Organization (SASO), the Gulf Countries Standards (GCS) as well as the standards of the World Health Organization (WHO), with respect to their calcium level. On the other hand, silica is not listed in any of the abovementioned organizations.

Dietary intake of silicon ranges from 20 to 50 mg per day for the majority of populations in Europe and USA (Jugdaohsingh *et al.*, 2002). Weathered rocks and minerals in soil are the primary sources of silicon in the drinking water. Silicon derived from the drinking water and fluids and this can account for approximately 20% of the daily requirement of silica (Jugdaohsingh *et al.*, 2002). Silica occurs in foods such as onions, cucumbers, wheat, whole grains, green leafy vegetables, oats, strawberries, avocados and brown rice (Sommers, 2007). Silica occurs also in herbs such as nettle and horsetail. Whole grains are a large part of a silica-rich diet. The average diet of the population in Al Qurayyat lacks the above mentioned food items which could lead to a remarkable decrease of silica. Therefore, the body may become more susceptible to infection and general poor health or age related problems. Moreover, because food processing plays a major role in our society and day life, our bodies do not get the proper daily needs of silicon. Poor menu selections in combination with limited food sources in Al Qurayyat necessitate the acquisition of natural silica supplement. A number of

Alzheimer's disease. Rondeau *et al.* (2009) found that silica delays dementia, which is closely related to Alzheimer. This cleansing effect helps to purge the body of the harmful impacts of aluminum and this makes benefit to the cardiovascular system.

One is born with an abundant amount of silica and relatively low amount of calcium. As the human gets older, the amount of calcium increases and the amount of silica decreases. As the body ages, it absorbs silica at a low rate. Such decline of silica leads to a more rapid manifestation of age related health issues. Silicon facilitates the absorption of calciferol and calcium which maintain the strength of bone, however they cannot do this task alone. To make the bones hard and flexible, bone growth includes adding calcium and increasing the amount of collagen. Silica is an essential mineral for hardness and flexibility and defends connective tissues. Moreover, it essential to form bridges between oxygen and silicon (Sommers, 2007). Deficiency of silica leads to many health problems, for example softening and decay of the bones and teeth, hardening of the arteries, poorly formed bones, skull, collagen, cartilages and joints, and mineral imbalance in the vertebrae and femur (Jugdaohsingh, 2007).

Chemical analysis of the water brands in the present study showed that silicon and calcium levels varied significantly among different water brands. Silicon was not detected in the domestic bottled drinking water brands, manufactured in the Kingdom of Saudi Arabia. However, silicon showed relatively high levels in the imported bottled drinking water brands, manufactured in France. Calcium was detected in all the water brands supplied to the population in Al Qurayyat. However, it ranged from

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health related issues can be prevented by maintaining a considerable amount of silica in our cells and tissues.

Calcium level in the blood stream is maintained by withdrawing calcium abundant in the bones. This makes the bones brittle, a health conditions known as osteoporosis. The daily intake of calcium is 1000-1200 mg. Milk, yogurt, cheese and ice cream are calcium-rich foods. They contain hormones and fats. Similarly, cream cheese, cream and butter contain fats and are not merely beneficial. Calcium deficiency causes arthritis, high blood pressure and osteoporosis (Tacon, 2011).

It is worth noting that it is not practical to get daily need of silica only from the food as many of the foods are processed with the amount of silica greatly reduced during the refinement process. The present study recommends the supplementation of the drinking water with considerable amounts of calcium and silicon to compensate for their deficiency in the daily intake of food. One intending to take a natural supplement such as silica should communicate and discuss with a physician to prevent interactions between calcium-rich food and prescribed medications. The medical history should be reviewed to avoid any complications.

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Figure 1. Comparison of the calcium level between imported and domestic brands of the bottled water available in Al Qurayyat. Imported water is represented by Evian and Volvaic brands.

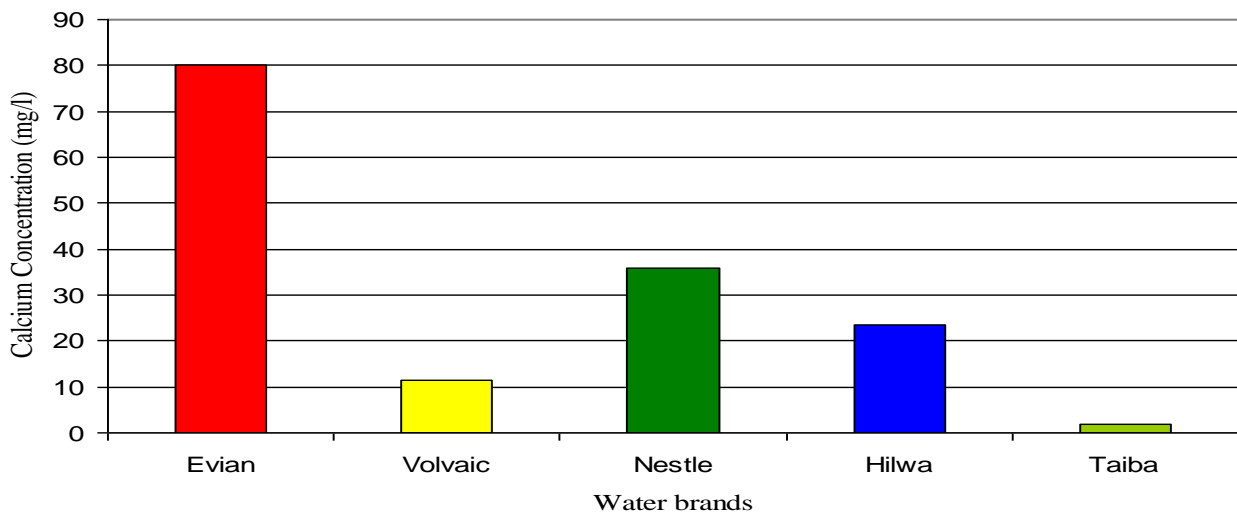


Figure 2. Comparison of the silica level between the imported water brands and the household, local and purified water brands available in Al Qurayyat.

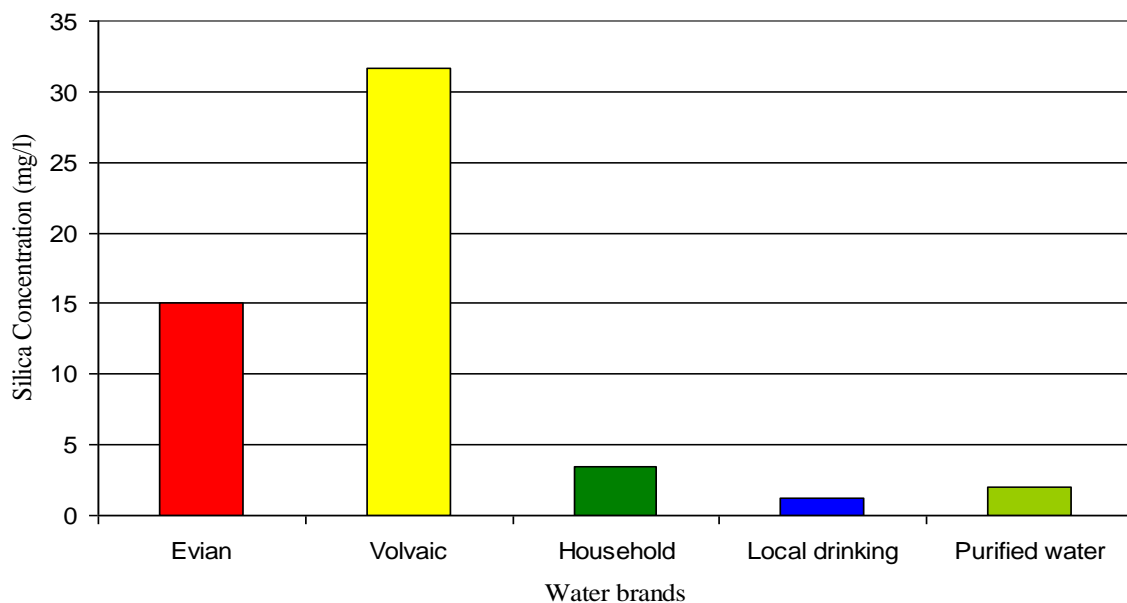


Figure 3. Silica concentration in a variety of household water brands supplied to the population in Al Qurayyat.

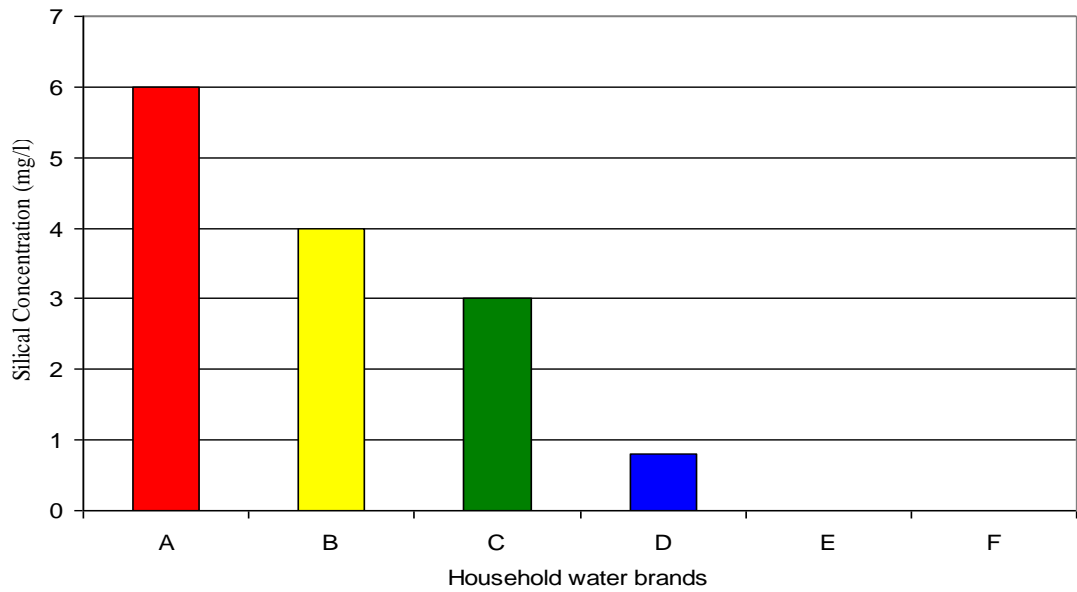


Figure 4. Silica concentration in a variety of local drinking water brands supplied to the population in Al Qurayyat.

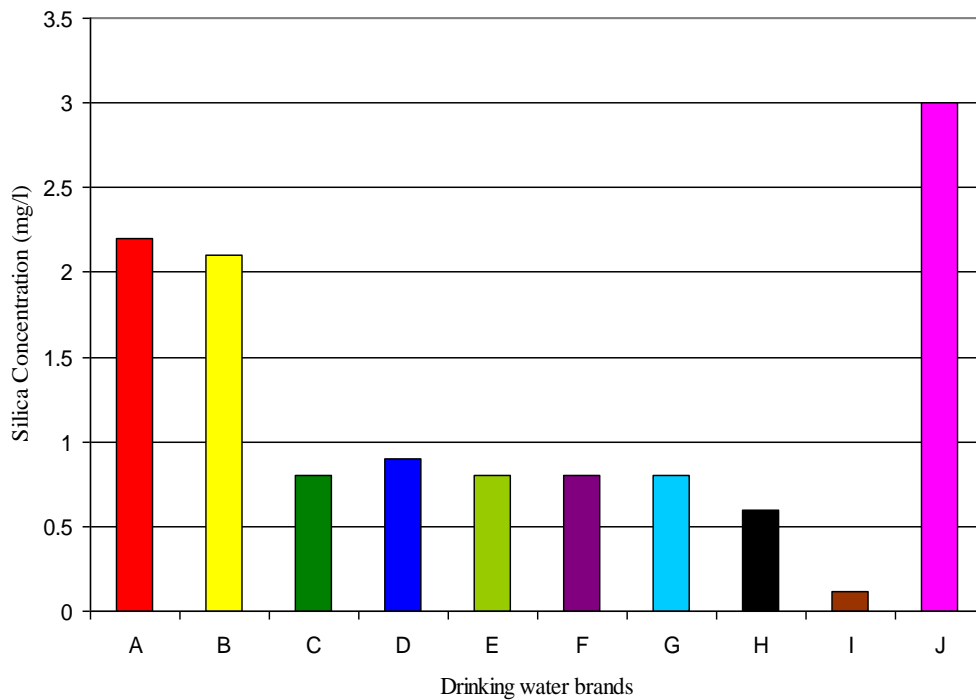


Figure 5. Calcium concentration in a variety of household water brands supplied to the population in AlQurayyat.

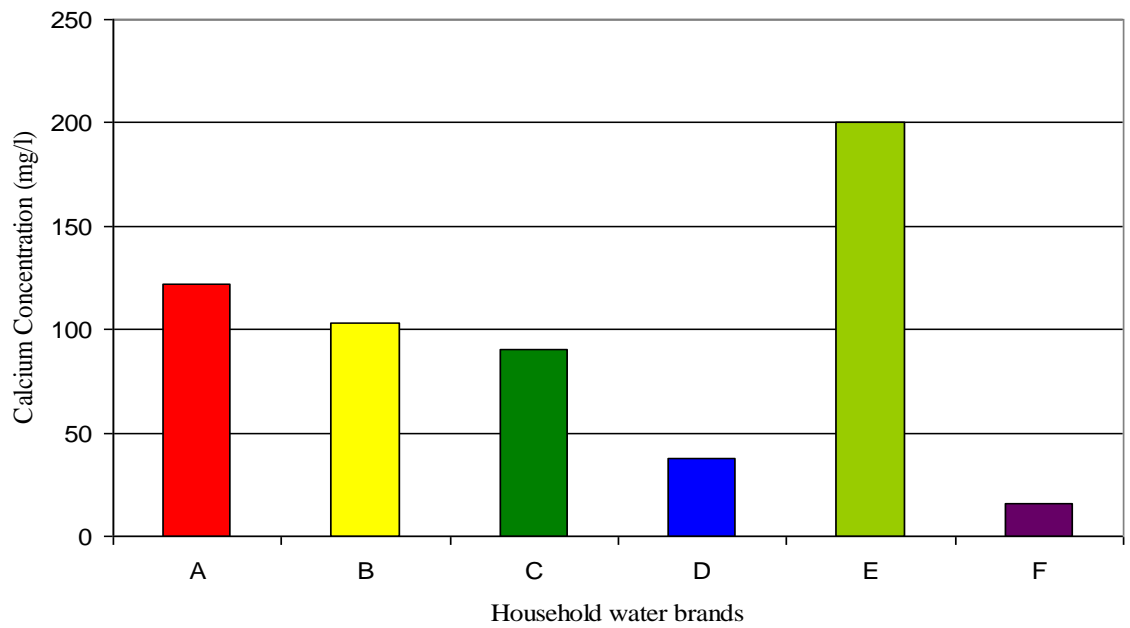


Figure 6. Calcium concentration in different local drinking water brands supplied to the population in Al Qurayyat.

