

Calcium Supplement: Humanity's Double-Edged Sword

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The principle aim of the present study is to investigate the dark side of calcium, pollutions in calcium preparation especially lead (Pb), mercury (Hg) and cadmium (Cd). The collected samples were the different calcium salts in the market and 18 preparations which were classified into 3 groups: Calcium carbonate salts, Chelated calcium and natural-raw calcium. All samples were analyzed for lead, cadmium and mercury by inductively Coupled Plasma Mass Spectrometry (ICP-MS) technique, in house method based on AOAC (2005) 999.10 by ICP-MS.

The calcium carbonate and the natural-raw calcium in every sample contained lead at 0.023-0.407 mg/kg of calcium powder. Meanwhile, the natural-raw calcium such as oyster, coral and animal bone showed amount of lead at 0.106-0.384 mg/kg with small amounts of mercury and cadmium. The chelated calcium such as calcium gluconate, calcium lactate and calcium citrate are free of lead.

Keywords: Calcium, Pollution, Lead, Cadmium, Mercury

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Calcium (Ca) is the main part of the bone mineral; it makes bone rigid and healthy. It also plays other important roles in the body such as muscle contraction, nerve conduction and blood clotting. Normally, the authors body has a mechanism of calcium preservation which is a continual process throughout life, but in some conditions such as osteoporosis, high bone turnover, the calcium becomes loss vigorously. Thus, calcium preparations need to be considered for treatments. Sometimes the calcium is used as a mineral supplement especially in pregnant women, children, the breast feeding period, and during the fracture healing. This mineral becomes a popular use worldwide. However, the dark side of calcium was reported: coronary occlusion⁽¹⁾ renal stone⁽²⁾, constipation and toxic effects of contaminated metals.

The toxic minerals contaminated in calcium supplement reported in the past were Lead (Pb), Cadmium (Cd), Mercury (Hg) and Arsenic (As)^(3,4). The amount of toxic minerals: Mercury, Cadmium and Arsenic were 0.01, 0.02, 0.48 mg/kg respectively⁽³⁾.

The common sources of lead are color

painting, ceramic dyes, the low grade benzene and some calcium supplements especially those derived from limestone. However, the minimum dose of lead is 7.5 mg/1,000 mg of calcium accepted by FDA of the USA. The chronic lead poisoning includes muscle pain, nausea, headache, immune decline, anemia, multiple sclerosis and also linking with high blood pressure and renal failure.

The mercury is commonly found in dental amalgams, seafood (Tuna), shark cartilage and some types of calcium preparations.

The cadmium is directly related to cigarette smoke which is the major source of producing this mineral. One cigarette contains approximately 1 microgram of cadmium. Another main source is seafood especially crabs, lobsters, oysters and clams which have the highest cadmium level compared with the internal organs of cattle if those aqua animals live by eating the plants or grasses which nourished by fertilizer⁽⁵⁾. Cadmium is deposited mainly in kidneys and prostate gland. In addition, cadmium can cause 'hardening' of the arteries (arteriosclerosis) and high blood pressure. It also disturbs the bone metabolism causing osteoporosis⁽⁶⁻⁸⁾.

Additionally, not only the small amount of toxic metals found in calcium preparations can lead to health problems, but the long-term exposure to toxic

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metals even a tiny amount will also cause hazards to human health, *i.e.* failure of many organs, for instance, liver, kidneys, bone, brain, lungs and bone marrow. The alternative choice of toxic-metals free should be considered for calcium preparations.

Material and Method

Drugs were prepared in separated ways. The capsule form was peeled and collected only the powder in the capsule whereas the drugs in form of tablet were grounded by pestle and mortar. The contamination of lead, mercury and cadmium in each drug were analyzed by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) technique. The samples were classified into 3 groups: Calcium carbonate origin, Chelated calcium (calcium bound to organic acids) and natural raw calcium.

Results

The toxic substances were found in many preparations of calcium (Table 1).

Discussion

The purpose of the present study is to remind people who frequently used calcium preparation in the market should be aware of the toxic minerals in calcium as the pollution. Though the amounts of toxic minerals are small, these minerals certainly accumulate in the body for long life because the half-lives of those toxic minerals are long, for example, the half life of lead is 20 years. According to our daily indoor and outdoor activities at present, the authors are exposed to the hazardous environments containing the toxic pollution, *e.g.* lead, cadmium and mercury. This circumstance will increase the amount of toxic minerals to the body with calcium intake.

The salt of calcium carbonate and natural-raw calcium such as oyster, coral and hydroxyapatite are plenty of toxic minerals. The present study showed that every sample of calcium contained such minerals. The chelated calcium, calcium gluconate, calcium lactate, calcium citrate are free of toxic miners or has only tiny amount that each calcium can be an alternative

Table 1. The results of contaminated minerals in 18 calcium preparations in Thai markets. The calcium carbonate contained lead that was 0.075-0.407 mg/kg. The samples of the other toxic metals were randomly found that they were contaminated by cadmium and mercury at 0.277-0.377 mg/kg, 0.018-0.025 mg/kg respectively.

| | Lead | Cadmium | Mercury | |
|------|--------|---------|---------|----------------|
| TN1 | 0.21 | NA | NA | Cal carbonate |
| TN2 | 0.153 | 0.277 | 0.025 | Cal carbonate |
| TN3 | 0.276 | NA | NA | Cal carbonate |
| TN4 | 0.023 | NA | NA | Cal carbonate |
| TN5 | 0.117 | NA | NA | Cal carbonate |
| TN6 | 0.17 | NA | NA | Cal carbonate |
| TN7 | 0.267 | NA | <0.018 | Cal carbonate |
| TN5 | <0.075 | NA | NA | Cal carbonate |
| TN6 | 0.407 | NA | NA | Cal carbonate |
| TN7 | 0.341 | 0.377 | <0.018 | Cal carbonate |
| TN8 | 0.38 | NA | NA | Cal carbonate |
| TN9 | 0.125 | NA | NA | Cal carbonate |
| TN10 | 0.129 | NA | NA | Cal carbonate |
| TN11 | ND | NA | <0.018 | Cal.citrate |
| TN12 | <0.075 | NA | NA | Cal.citrate |
| TN13 | 0 | NA | NA | Cal.citrate |
| TN14 | NA | ND | 0.032 | Cal.citrate |
| TN15 | 0 | NA | NA | Cal lactrate |
| TN16 | 0 | NA | ND | Cal gluconate |
| TN17 | 0.106 | NA | NA | Oyster |
| TN18 | 0.217 | NA | NA | Hydroxyapatite |
| TN19 | 0.384 | 0.132 | ND | Coral |

Note: ND = not detected, NA = not available check

treatment.

The calcium carbonate preparations had high risks of contamination. Every sample after the random selection of the calcium carbonate contained lead. The two samples of calcium carbonate showed all toxic metals: lead, cadmium and mercury (Table 1). The calcium preparations from natural sources such as coral, oyster and hydroxyapatite (TN17-TN18 in Table 1) contained lead in different concentrations while the other toxic metals could not be examined because the capacity of the laboratory was not available.

Potential conflicts of interest

None.

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การใช้แคลเซียมเป็นดาบสองคม

ณรงค์ บุญยะรัตเวช, ชุตติเพ็ญ บุรณะสินทรัพย์

จุดประสงค์งานวิจัยนี้เพื่อเป็นการเตือนว่าการใช้แคลเซียมก็มีข้อเสียเช่นกัน เนื่องจากมีสารปนเปื้อนเช่น ตะกั่ว ปรอท และแคดเมียมซึ่งเป็นสารพิษและมีครึ่งชีวิตในร่างกายนาน เช่น ตะกั่ว มีครึ่งชีวิต 20 ปี จริยอยู่สารเหล่านี้มีปริมาณน้อย แต่ความเป็นจริงคือการใช้แคลเซียมกับคนไข้จะใช้กันนานติดต่อกันเป็นปี สารหรือธาตุเหล่านี้มีการตกค้างสะสมเนื่องจากการขับถ่ายออกยาก นอกจากนี้ในสิ่งแวดล้อมร่างกายก็ได้สารพิษอยู่แล้ว การให้แคลเซียมที่มีสารปนเปื้อน ยิ่งไปซ้ำเติมอีกโดยไม่จำเป็น

แคลเซียมคาร์บอเนต ในกลุ่มตัวอย่าง พบว่ามีตะกั่วทุกตัวอย่าง ตั้งแต่ 0.023 ถึง 0.407 มก. ต่อน้ำหนักยา เป็นกิโล สำหรับแคลเซียมที่ได้มาจากธรรมชาติโดยตรง ได้แก่จาก ปะการัง เปลือกหอย และจากกระดูกสัตว์ มีตะกั่วตั้งแต่ 0.106 ถึง 0.384 มก./กก. และมีการปนเปื้อนของ แคดเมียมและปรอทบ้าง จากการศึกษาแคลเซียมในกลุ่ม คีเลต เช่น แคลเซียม ไกลโคเนต แคลเซียม แล็คเตต และ แคลเซียม ซิเตรต พบว่าไม่มีตะกั่วและสารปนเปื้อนอื่นๆ จึงนับว่าเป็นทางเลือกที่ค่อนข้างปลอดภัย