

Medical Detective

Lead poisoning from drinking Kombucha tea brewed in a ceramic pot

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MJA 1998; 169: 644-646

Kombucha tea is an alternative therapy that is gaining popularity as a remedy for a diverse range of ailments. We report two cases of symptomatic lead poisoning requiring chelation therapy in a married couple who had been drinking Kombucha tea for six months, brewing the tea in a ceramic pot. We postulate that acids in the tea eluted lead from the glaze pigment used in the ceramic pot, in a manner analogous to elution of lead from crystal decanters by wine and spirits.

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Introduction Lead is a ubiquitous enzymatic poison which can be found in the air, soil and drinking water. The addition of lead salts to paint at the beginning of the 19th century, and tetraethyl lead to petroleum in the 20th century, has increased environmental levels of lead, particularly in dense urban areas.¹ Less-common sources of lead include cosmetics, ceramics, leaded crystal and old newsprint. Daily ingestion of more than 5 µg of lead/kg body weight will result in a positive lead balance and rising lead levels.² Lead preferentially binds to the sulfhydryl groups of proteins and denatures them, causing cell death and tissue inflammation. Impaired haemopoiesis results in sideroblastic anaemia. Damage to the kidney may result in tubular necrosis and renal failure, Fanconi syndrome (type 2 proximal renal tubular acidosis), saturnine gout, and hypertension. Neurotoxicity may result in peripheral neuropathy, sensorineural deafness, metabolic encephalopathy, and neurodevelopmental delay. Colicky abdominal pain and constipation are frequent presenting symptoms.

We report two cases of lead poisoning in a married couple who had been drinking Kombucha tea brewed in a ceramic pot. The tea is a mildly alcoholic beverage produced by fermenting sweet black tea with the Kombucha "mushroom" in a glass, porcelain or ceramic pot. The mushroom itself is a symbiosis of yeast and bacteria bound by a thin, permeable membrane. It is gaining popularity as an alternative therapy for a diverse range of ailments such as insomnia, hair loss, impotence, obesity, chronic fatigue syndrome, asthma, multiple sclerosis, rheumatoid arthritis, cancer, and AIDS.³

Clinical record

A 58-year-old woman presented to the Emergency Department at the Prince of Wales Hospital with a six-week history of increasing constipation and colicky abdominal pain. She was treated with laxatives and discharged. Review of her blood film showed a hypochromic anaemia (Hb, 108 g/L) with polychromasia and basophilic stippling of her red blood cells (Figure 1).

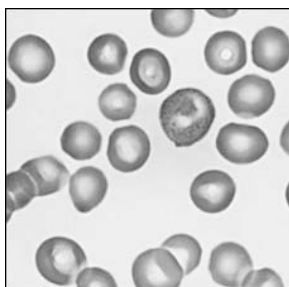


Figure 1: Peripheral blood film, showing polychromasia and basophilic stippling.

Lead poisoning was suspected, and a urine lead level was ordered. Iron studies and a haemoglobin electrophoretogram were normal. Her 24-hour urinary lead level was 1.42 µmol/L (normal range, 0.0-0.4 µmol/L) and her blood lead level was 5.95 µmol/L (normal range, 0.0-0.48 µmol/L). Her 63-year-old husband was found to have a blood lead level of 4.49 µmol/L. He was a retired telephone operator who had had no exposure to lead during his working life. His only symptom was fatigue. They had no children and there were no family pets. Six months earlier both the patient and her husband started drinking Kombucha tea as a tonic. They brewed the tea in a ceramic pot and ingested one tall glass (about 250 mL) every morning.

An elevated blood lead level has been notifiable under the *Public Health Act* 1991 (NSW) since 1 December 1996; accordingly, the South Eastern Sydney Public Health Unit was notified. Samples of soil, paint chips, household dust, and dust from venetian blinds were taken from the family home and analysed. No environmental source of lead was found. However, samples of the Kombucha tea contained 173 mg/kg of lead. The Australian Food Standards Code A12 -- Metals and Contaminates in Food requires a lead level of less than 0.2 mg/kg in beverages and other liquid foods. After brewing in the ceramic pot, the Kombucha mushroom contained 329 mg of lead/kg dry weight, the maximum permitted being 0.5 mg/kg.

The tea was brewed in a ceramic pot with internal glazing (Figure 2), and testing found a lead level of 198 mg/L of extract solution.



Figure 2: The ceramic pot in which the Kombucha tea was brewed. The glaze has visibly eroded from the internal and external surfaces of the pot.

The Food (General) Regulation 1997 (NSW) requires food vessels to comply with the British Standard Specification of Limits of Metal Release from Ceramic Ware, Glassware, Glass Ceramic Ware and Vitreous Enamel Ware (BS 6748: 1986), which specifies a maximum lead level of 4.0 mg/L of extract solution. This standard refers to containers used for food storage, and it is likely that the ceramic pot, which had been imported from Spain 25 years earlier, was not intended for food use.

Both patients were offered outpatient chelation therapy with calcium disodium edetate. They received a course of five intravenous infusions of one gram of calcium disodium edetate given at two-day intervals. At follow-up six months later, the woman's anaemia and constipation had resolved and her blood lead level had fallen to 1.42 $\mu\text{mol/L}$. Her husband remained symptom-free and his blood lead level had fallen to 1.52 $\mu\text{mol/L}$.

Discussion Lead contamination of food and beverages has long been recognised. In 1991, Graziano and Blum showed that wine and spirits stored in crystal decanters could elute lead from the vessel over time to produce potentially highly toxic levels of lead.⁴ They correlated the rise in the lead concentration in port or brandy with the lead content of the crystal decanter and the time that the port or brandy was decanted. In fact, lead poisoning has been postulated as the cause of the epidemics of gout in the nobles of 18th- and 19th-century Britain and the aristocrats of the Roman Empire.⁵ The consumption of port in England in the 18th and 19th century was paralleled by the high incidence of gout, and lead levels in fortified wines bottled between 1770 and 1820 are as high as 300-1900 $\mu\text{g/L}$.⁵ The pandemics of gout among Roman aristocrats have also been linked to chronic lead poisoning from contaminated wines. Roman wines contained boiled-down grape syrup (*sapa*), which had to be simmered in either a lead pot or a lead-lined copper kettle. Attempts to prepare *sapa* according to ancient recipes have produced lead concentrations of 240-1000 mg/L of boiled-down must.⁶ Nriagu reviewed the lifestyles of the Roman emperors and usurpers, and speculated that their predilection for lead-tainted Apician entrees⁷ and Columellan wine blends⁸ contributed to widespread plumbism and the fall of the Roman Empire.⁹

In a report similar to ours, Scarlett et al described lead poisoning in a married couple who ingested non-alcoholic carbonated beverages from a pewter drinking mug.¹⁰ Traditional pewter mugs contain 25% lead and 75% tin, and are not recommended for food and drink containers. Highly toxic lead concentrations may result from elution of lead from the pewter by the acidity of effervescent non-alcoholic beverages.

Kombucha tea contains 0.5%-1.5% alcohol, and organic acids such as acetic and lactic acid, which produce a pH of 2.5.¹¹ The literature on Kombucha recommends the tea be brewed in a glass, porcelain or ceramic pot to obtain the best results.³ However, some decorative bowls contain high levels of lead oxide in the glaze or pigments used in the ceramics. Acidic beverages stored in these containers may elute the heavy metal from the bowl and produce harmful levels of lead in the brew, in a manner analogous to the elution of lead from crystal decanters by wine and spirits, and from pewter by non-alcoholic carbonated beverages. Failure to fire the kiln to a high enough temperature during glazing can result in inadequate fixation of the glaze pigments to the ceramic bowl, which can potentiate this effect.

Kombucha tea itself has been associated with toxic reactions. There have been two case reports from Iowa of unexplained severe illness associated with drinking Kombucha tea.¹² Both patients had a severe metabolic acidosis with high serum levels of lactate, the cause of which could not be determined. There have also been warnings of potential hepatotoxicity following the report of a man who developed a skin rash, hepatomegaly and abnormal liver function tests after drinking the tea for one month.¹¹ His symptoms resolved and his liver function tests normalised when he stopped taking the tea. In another four cases, one patient developed jaundice and abnormal liver function tests, the second had non-specific complaints of dry mouth, dizziness, nausea and vomiting, and neck pain, and the other two patients were thought to have developed allergic reactions.¹³

The history of chronic ingestion of Kombucha tea over six months and demonstration of highly toxic levels of lead in both the tea and mushroom confirm that it was the source of the lead poisoning in our patients. We postulate that their exposure to lead (estimated to be about 43 mg/day) resulted from ingestion of Kombucha tea which had been brewed in a ceramic pot that was not properly glazed and was probably never intended for food storage. This method of brewing is potentially harmful. Patients with unexplained lead poisoning should be questioned about their use of alternative therapies, and their methods of food preparation and storage.

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