A note on the sensitivity of a method used to detect lead in the eighteenth century

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The extent of the lead hazard in the eighteenth century can be judged by the large number of synonyms which were in current use for lead poisoning. These included the colic of Poitou, the painter's colic, the colic of Devonshire, the bellain of Derbyshire, the mill reek, and the dry gripes of the West Indies. Those which were not due to occupational exposure resulted from the incorporation of lead into cider or rum making apparatus, the adulteration of wine with lead, and the use of badly glazed earthenware for cooking or storing food.

Chemical analyses were frequently made to detect the presence of lead, the most famous experiments being those which George Baker conducted during his investigation of the Devonshire colic (Baker, 1767). Two types of analyses were used. Either the solution under examination was evaporated to dryness and the residue heated to obtain molten lead, or a test solution was added which produced a precipitate in the presence of lead. The sensitivity of one of these test solutions was examined in the following experiment.

The solution was prepared following Hardy's (1778) instructions. Two ounces (62 g) of orpiment (As_2S_3) were mixed with 1 oz (31 g) of quicklime, and 12 oz (340 ml) of distilled water were added. The mixture was boiled under reflux for 30 minutes and filtered before use. During the preparation of the test solution calcium orthosulpharsenite ($\text{Ca}_3(\text{AsS}_3)_2$) is formed which decomposes in part during heating to form $\text{Ca}_3(\text{AsS}_4)_2 + \text{CaS} + \text{As}$. The addition of Pb^{++} produces a precipitate which is a mixture of PbS , $\text{Pb}_3(\text{AsS}_3)_2$, $\text{Pb}_3(\text{AsS}_4)_2$, and, possibly, $\text{Pb}_2(\text{As}_2\text{S}_5)$.

The lead solutions tested were prepared from stock solutions of lead acetate (100 mg Pb/litre), one using distilled water as the solvent and the other

cider. Final solutions containing 10, 5, 4, 3, 2, and 1 mg Pb/litre were prepared by dilution with distilled water or cider.

To 10 ml of each of these dilute solutions 5 drops of the test solution were added with the following results:

Aqueous solutions: A precipitate was obtained in all cases. The colour of the precipitate varied from an intense black in the strongest solution to a brown-black in the weakest. No precipitate was obtained with distilled water.

Cider solutions: Addition of the test solution produced a curdy precipitate which partially obscured the dark lead precipitate. The lead precipitate was obvious in all the cider solutions down to a concentration of 2 mg/litre but less obvious in the most dilute solution. Nevertheless by careful comparison with normal cider with 5 drops of test solution added it was possible to detect the presence of a brown coloration in the precipitate.

This experiment demonstrates that it would have been possible for investigators in the eighteenth century to detect lead in toxic concentrations using the rather crude method described here.

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References

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