Lead Extraction from Aluminum

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Lead poisoning can result from the continued daily intake of lead in amounts as little as one mg per day (KEHOE, 1964). Therefore, it is important that all potential sources of lead be identified and steps taken to prevent its ingestion. Ceramics have been found to be a particularly notorious source of this metal (BLOCK, 1969; HARRIS AND ELSEA, 1967; KLEIN, et al., 1970; LEONARD and LYNCH, 1958; SETH, et al., 1973b; WHITEHEAD and PRIOR,1960). Also, various foods and beverages have been found to contain small amounts of lead (BAGCHI, et al., 1940; BENSON, et al., 1974; KEHOE, et al., 1940; SETH, et al., 1973a). Aluminum, which contains lead as an impurity, is used extensively in applications in which it comes into contact with food items. Therefore, it was of interest to examine samples of aluminum products for lead content and lead leaching.

Materials and Methods

Samples

Various aluminum products (foil, pans, cans, pie plates) were randomly chosen for analysis.

Equipment

A Perkin-Elmer Model 303 Atomic Absorption Spectrophotometer was used.

Reagents

Analytical-grade reagents and doubly-distilled water were used.

Method

1. Analysis for lead in aluminum

One gram of the aluminum product was dissolved in hydrochloric acid, and the solution was made up to 25 ml total volume. Atomic absorbtion was used to determine the lead concentration. Lead standards were used to obtain an absorbance versus concentration plot. Linearity was observed for the range 0-15 mg/liter of lead. Two different wavelengths (217nm and 283nm) were utilized as a check for interferences; identical results were obtained for both.

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2. Analysis for lead leached from aluminum

The containers were rinsed with distilled water, then filled with 5% acetic acid solution. The samples were covered with Saran (controls showed it to be lead-free) and maintained at 85°C for six hours. After this treatment, the volume of each extractant was made up to its original volume.

Results

The lead content of the aluminum products varied from 28 to 45 ppm (Table 1). At room temperature the amount of lead leached from the containers was negligible (<0.1 mg/liter). At 85°C, however, the amount leached was significant (Table 2). Successive extractions removed less lead each time; by the fifth extraction, the concentration of lead in the extractant was less than 0.1 mg/liter.

Table 1

Lead Content of Aluminum Samples

Sample No.	Type of sample	Number of samples	Lead content, ppm
1	Foil	3	45.1
2	Foil	3	38.7
3	Foil	3	39.3
4	Foil	3	35.6
5	Pie plate	3	34.1
6	Pie plate	3	37.7
7	Pot	2	31.1
8	Pot	2	35.2
9	Pot	1	39.8
10	Pot	2	28.8
11	Pot	2	28.4
12	Pot	3	33.6
13	Can	2	31.5
14	Can	3	42.4

Discussion

As the data in Table 1 show, lead is present in aluminum products to the extent of 28-45 ppm. Although no appreciable lead leaching from the aluminum by the acid occurs at room temperature, at 85°C some lead removal does occur. The concen-

tration is well below the maximum of 7 mg/liter set by the United States Food and Drug Administration. Upon repeated extraction of the aluminum products, a significant reduction in the amount of lead leached is observed. Thus, it appears that the contact of aluminum with foods and beverages does not constitute an appreciable health hazard. However, since lead is a cumulative poison and small amounts of lead are leached from aluminum, it is recommended that aluminum vessels be conditioned by multiple extractions with dilute acetic acid at higher temperatures.

Table 2

Lead Concentration in 5% Acetic Acid Extractant After Storage in Aluminum Containers for Six Hours at 85°C

Sample No.	Type of Sample	Concentration of lead, in mg/liter
1	Pie plate	2.3
2	Pie plate	1.9
3	Pot	1.8
4	Pot	1.4
5	Pot	2.1
6	Pot	1.7
7	Pot	1.7
8	Pot	1.5
9	Can	0.3
10	Can	0.2

Summary

The lead content of various aluminum samples was determined. The amount of lead was found to be in the range from 28-45 ppm. The leaching of lead from aluminum products by 5% acetic acid was negligible at room temperature, but up to 2 mg/liter was leached at 85°C. Although no significant health hazard exists in the usage of aluminum in contact with food items, it is recommended that aluminum containers be conditioned by several extractions with dilute acetic acid at higher temperatures.

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