Supporting Information

Lead relative bioavailability in lip products and their potential health risk to women

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Spectroscopic Assessment of Lip Products. Two lip product samples with Pb concentrations of 7781 and 10,185 mg kg^{-1} were analyzed by XANES Spectroscopy at the Pb L_{III}-edge (13035) to determine Pb speciation. XANES data were collected at the Materials Research Collaborative Access Team (MRCAT) beamline 10-ID, Sector 10, at the Advanced Photon Source (APS) of the Argonne National Laboratory (ANL), U.S. The XANES data collection was conducted in fluorescence model using Ge detector (Canberra). The storage ring operated at 7 GeV in top-up mode. A liquid N_2 cooled double crystal Si(111) monochromator was used to select the incident photon energies and a platinum-coated mirror was used for harmonic rejection. The XANES spectroscopy data was collected from 75 eV below to 115 eV above the absorption edge. Lead chromate was used as reference spectra which were measured in transmission mode.

Table S1. Type, Price (USD), and Color of the 93 Lip Products Tested in This Study.

sample	type	price	color	sample	type	price	color	sample	type	price	color
1	Lipsticks	1.61	Red	32	Lipsticks	24.1	Pink	63	Lipsticks	4.50	Pink
2	Lipsticks	4.50	Red	33	Lipsticks	4.34	Blue	64	Lipsticks	2.89	Brown
3	Lipsticks	4.50	Pink	34	Lipsticks	12.9	Purple	65	Lipsticks	3.85	Pink
4	Lipsticks	4.50	Purple	35	Lipsticks	4.50	Pink	66	Lipsticks	2.89	Brown
5	Lipsticks	3.21	Red	36	Lipsticks	3.85	Red	67	Lipsticks	3.85	Red
6	Lipsticks	8.67	Brown	37	Lipsticks	2.89	Pink	68	Lipsticks	3.85	Pink
7	Lipsticks	0.64	White	38	Lipsticks	12.9	Orange	69	Lipsticks	2.89	Red
8	Lipsticks	6.75	Red	39	Lipsticks	28.9	Brown	70	Lipsticks	3.85	Pink
9	Lipsticks	4.34	Orange	40	Lipsticks	11.4	Red	71	Lipsticks	3.85	Purple
10	Lipsticks	19.0	Red	41	Lip glosses	1.12	Pink	72	Lip glosses	4.18	Pink
11	Lipsticks	17.0	Red	42	Lipsticks	12.9	Pink	73	Lip glosses	4.18	Pink
12	Lip glosses	6.42	Pink	43	Lipsticks	2.89	Brown	74	Lipsticks	3.85	Pink
13	Lipsticks	11.6	Pink	44	Lip glosses	4.18	Purple	75	Lip glosses	4.18	Pink
14	Lip glosses	1.28	Red	45	Lipsticks	4.82	Red	76	Lipsticks	3.85	Pink
15	Lipsticks	4.50	Orange	46	Lipsticks	12.9	Pink	77	Lipsticks	3.85	Brown
16	Lipsticks	2.89	Red	47	Lipsticks	12.9	Pink	78	Lip glosses	4.18	Pink
17	Lipsticks	25.7	Red	48	Lipsticks	3.21	Red	79	Lipsticks	3.85	Pink
18	Lipsticks	1.12	Green	49	Lipsticks	12.9	Red	80	Lip glosses	4.18	Pink
19	Lipsticks	4.34	Red	50	Lipsticks	2.89	Brown	81	Lip glosses	4.18	Pink
20	Lipsticks	4.50	Pink	51	Lipsticks	3.85	Pink	82	Lipsticks	3.85	Pink
21	Lipsticks	1.61	Pink	52	Lipsticks	10.6	Brown	83	Lipsticks	3.85	Pink
22	Lipsticks	5.14	Orange	53	Lipsticks	9.64	Brown	84	Lip glosses	4.18	Red
23	Lipsticks	4.50	Red	54	Lipsticks	12.9	Pink	85	Lipsticks	3.85	Orange
24	Lipsticks	2.89	Brown	55	Lip glosses	4.18	Pink	86	Lip glosses	4.18	Red
25	Lipsticks	2.89	Pink	56	Lipsticks	2.89	Purple	87	Lipsticks	3.85	Pink
26	Lip glosses	4.82	Pink	57	Lipsticks	12.9	Pink	88	Lip glosses	4.18	Yellow
27	Lipsticks	4.50	Red	58	Lipsticks	2.89	Red	89	Lipsticks	3.85	Pink
28	Lipsticks	4.50	Pink	59	Lipsticks	12.9	Red	90	Lip glosses	4.18	Pink
29	Lipsticks	4.34	Green	60	Lipsticks	12.9	Red	91	Lipsticks	3.85	Orange
30	Lipsticks	2.89	Orange	61	Lipsticks	12.9	Red	92	Lip glosses	4.18	Orange
31	Lip glosses	1.12	Purple	62	Lipsticks	12.9	Red	93	Lipsticks	3.85	Orange

Table S2. Estimated Daily Pb Intake Through Ingestion of Various Kinds of Foods.

food types	Pb concentration (mg kg^{-1})[a]	food intake rate (g day^{-1})[b]	daily Pb intake (μg Pb day^{-1})
Rice	0.2	238	47.7
Coarse cereal	0.2	23.6	4.72
Pulses	0.2	16.0	3.20
Vegetables	0.1	276	27.6
Fruits	0.1	45.0	4.50
Meat	0.2	78.6	15.7
Milk	0.3	26.6	7.98
Eggs	0.2	23.7	4.74
Aquatic products	0.5	29.6	14.8
Total intake		898	131

[a] The Pb concentration was guideline for safe limits of heavy metals obtained from Chinese national food sanitation standards (GB2762-2012).

[b] The data for food intake rate was obtained from Li et al.[1].

Table S3. Estimated Daily Pb Intake Through All Main Routes for Women with Body Weight (bw) of 50 kg.

sources	Pb concentration[a]	intake rate[b]	bioavailability[b] (%)	estimated daily Pb intake (μg Pb kg^{-1} bw d^{-1}) based on	
				total Pb [c]	bioavailable Pb [d]
Inhalation	0.5 μg m^{-3}	20 m^3 d^{-1}	50	0.2	0.1
Food intake	0.1–0.5 mg kg^{-1}	898 g d^{-1}	10	2.6	0.3
Water ingestion	0.01 mg L^{-1}	2 L d^{-1}	10	0.4	0.04
Soil ingestion	300 mg kg^{-1}	100 mg d^{-1}	50	0.6	0.3

[a] The Pb concentration of inhalation, food, water and soil were obtained from guidelines for safe limits by Ambient air quality standards (GB3095-2012), Chinese national food sanitation standards (GB2762-2012), Sanitary standards for drinking water quality (GB5749-2006), and Environmental quality standards for soils (GB15618-1995). [b] The intake rate and bioavailability was obtained from Chen et al.[2]. [c]Based on total Pb concentration in the individual exposure pathway. [d]Based on bioavailable Pb concentration in the individual exposure pathway, bioavailable Pb concentration was the product of total Pb concentration and Pb bioavailability .

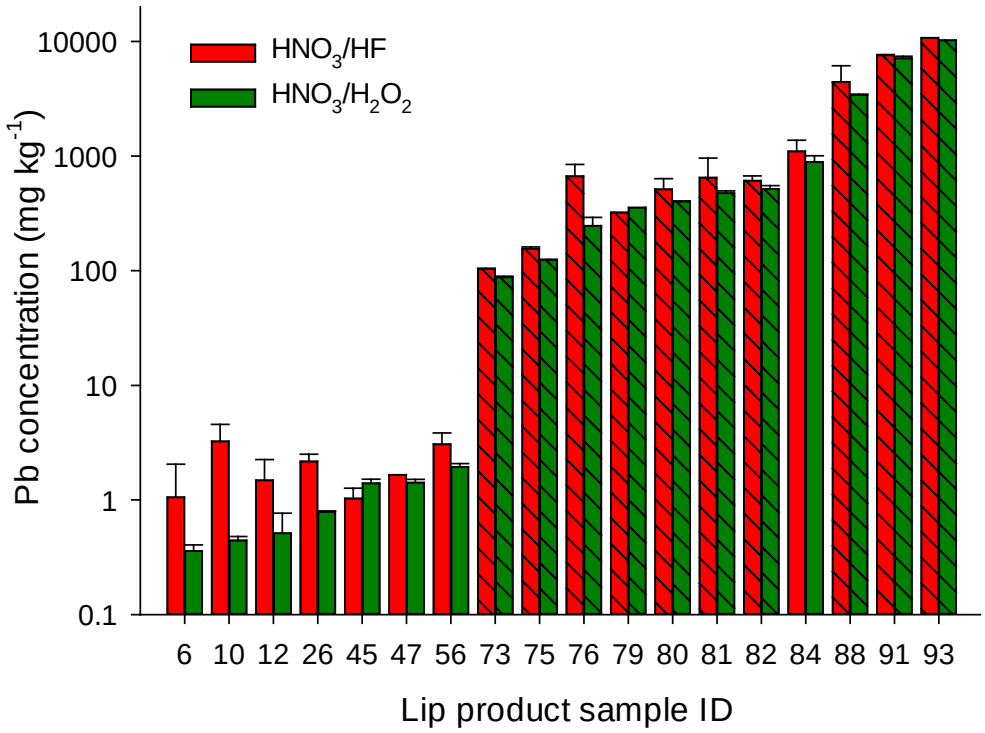

Figure S1. Comparison in Pb concentrations in 18 lip product samples determined using HNO_3/H_2O_2 and the microwave-assisted HNO_3/HF methods. Bars with slashes represents the lip products that were administered to mice for Pb-RBA determination.

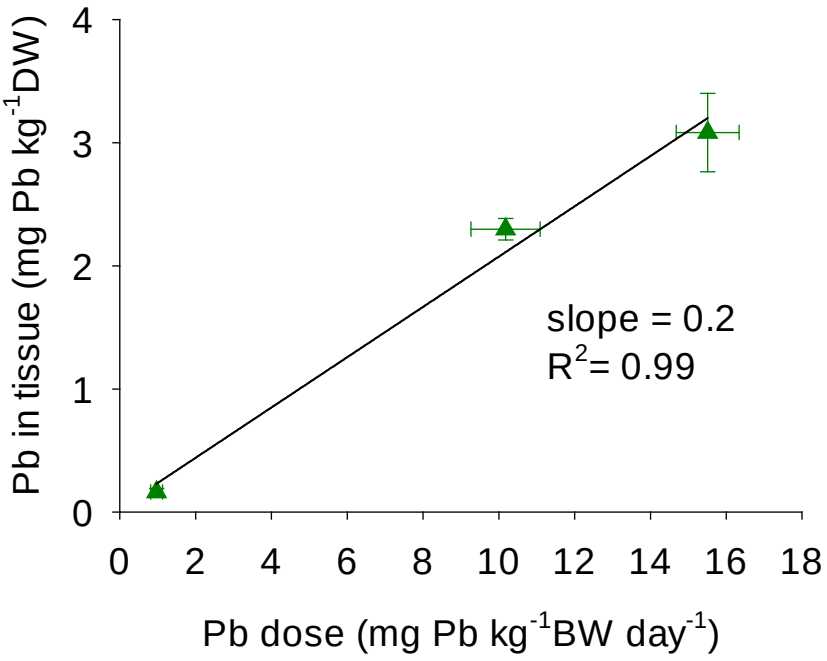

Figure S2. Dose-response curve for Pb accumulation in mouse femur following oral administration of Pb acetate via feeding for 7 days. Data points represent the mean and standard deviation of triplicate mice.

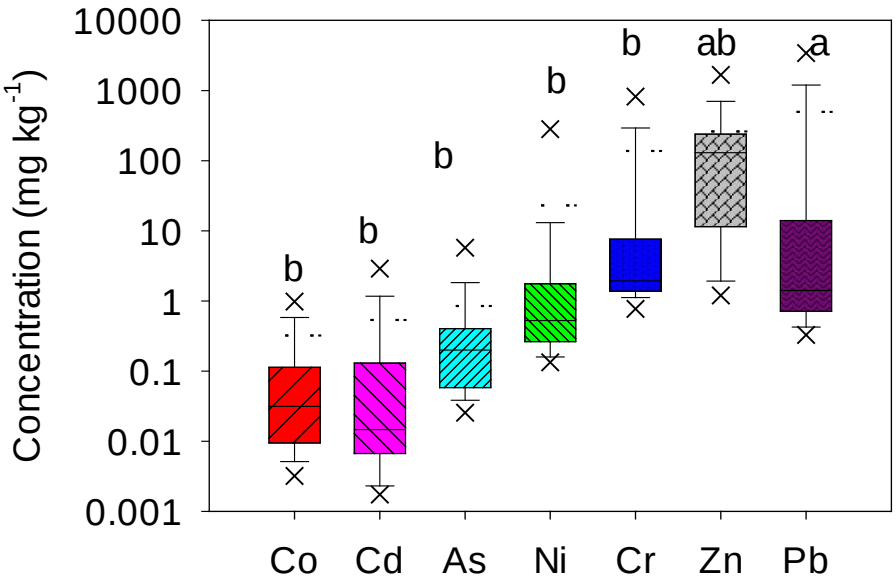

Figure S3. Box and whiskers plot showing total metal concentration in 93 lip product samples. Boxes extend from the 25th to the 75th percentile, horizontal solid and dashed lines bars inside the boxes represent the median and mean values, error bars represent the 5th and 95th percentiles, while X signs represent the 1st and 99th percentiles.

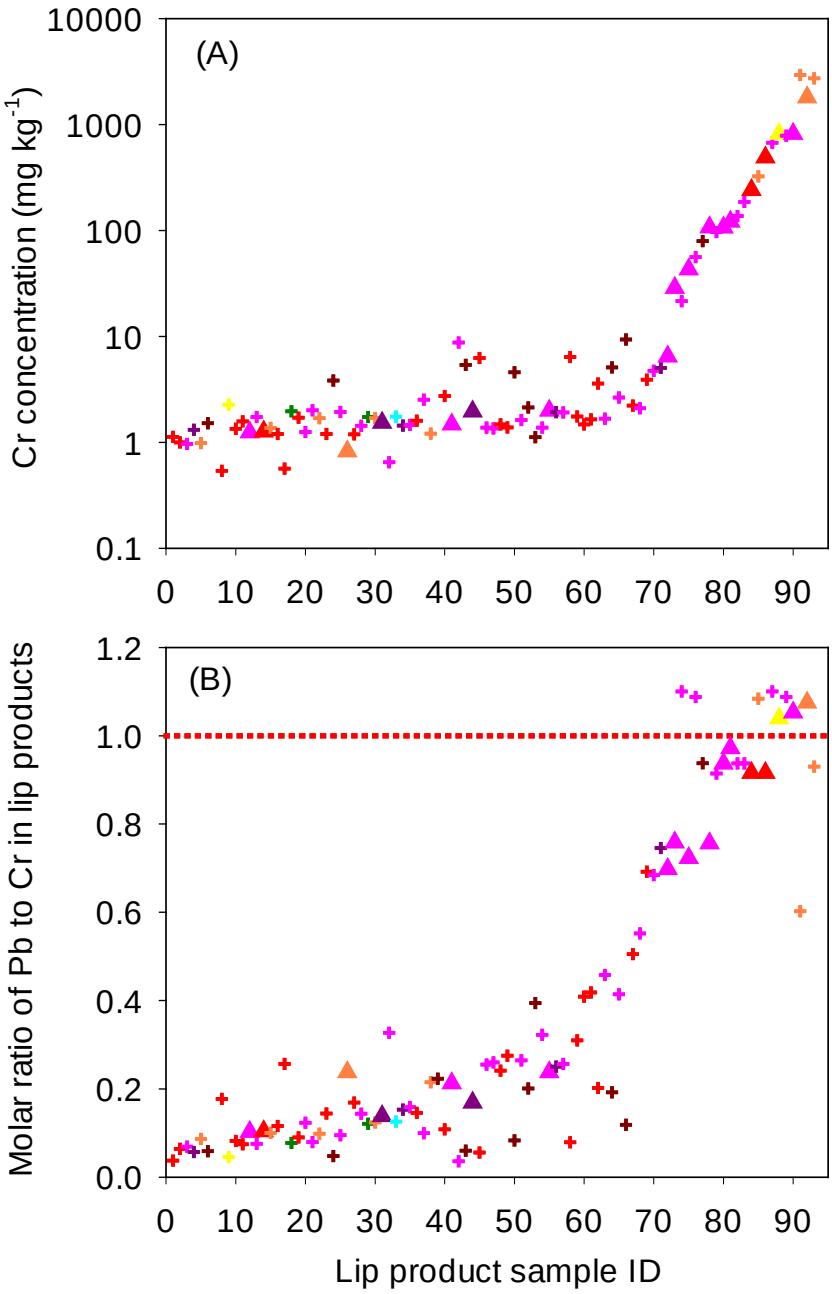

Figure S4. Total Cr concentrations (A) and mole ratio of Pb to Cr (B) in 75 lipstick (+) and 18 lip gloss (▲) samples purchased from retail stores and the internet of China. The color of each point in the figure represents the real color in the lip products.

References

(1) Li, G.; Sun, G. X.; Williams, P. N.; Nunes, L.; Zhu, Y. G. Inorganic arsenic in Chinese food and its cancer risk. *Environ. Int.* **2011,** *37*, (7), 1219–1225.

(2) Chen, L.; Xu, Z.; Liu, M.; Huang, Y.; Fan, R.; Su, Y.; Hu, G.; Peng, X.; Peng, X. Lead exposure assessment from study near a lead-acid battery factory in China. *Sci. Total Environ.* **2012,** *429*, 191–198.