

Heavy Metal Exposure in Common Childhood Food Staples - The Peanut Butter & 'Jelly' Studies

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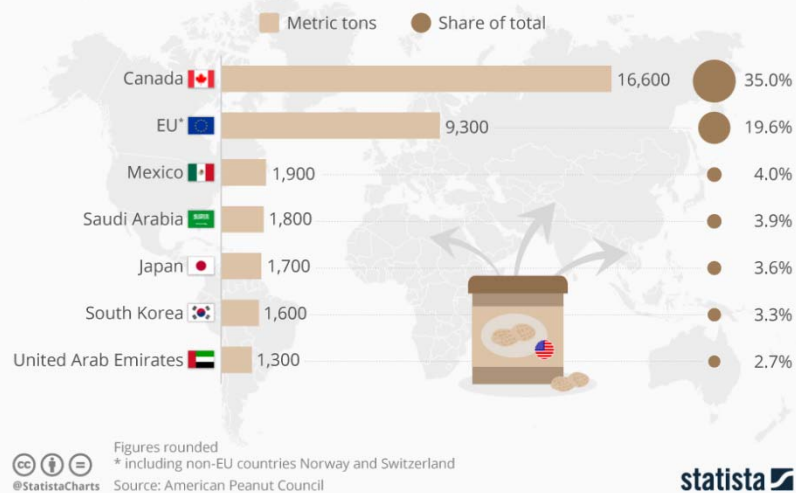
Peanuts: *Arachis hypogea*

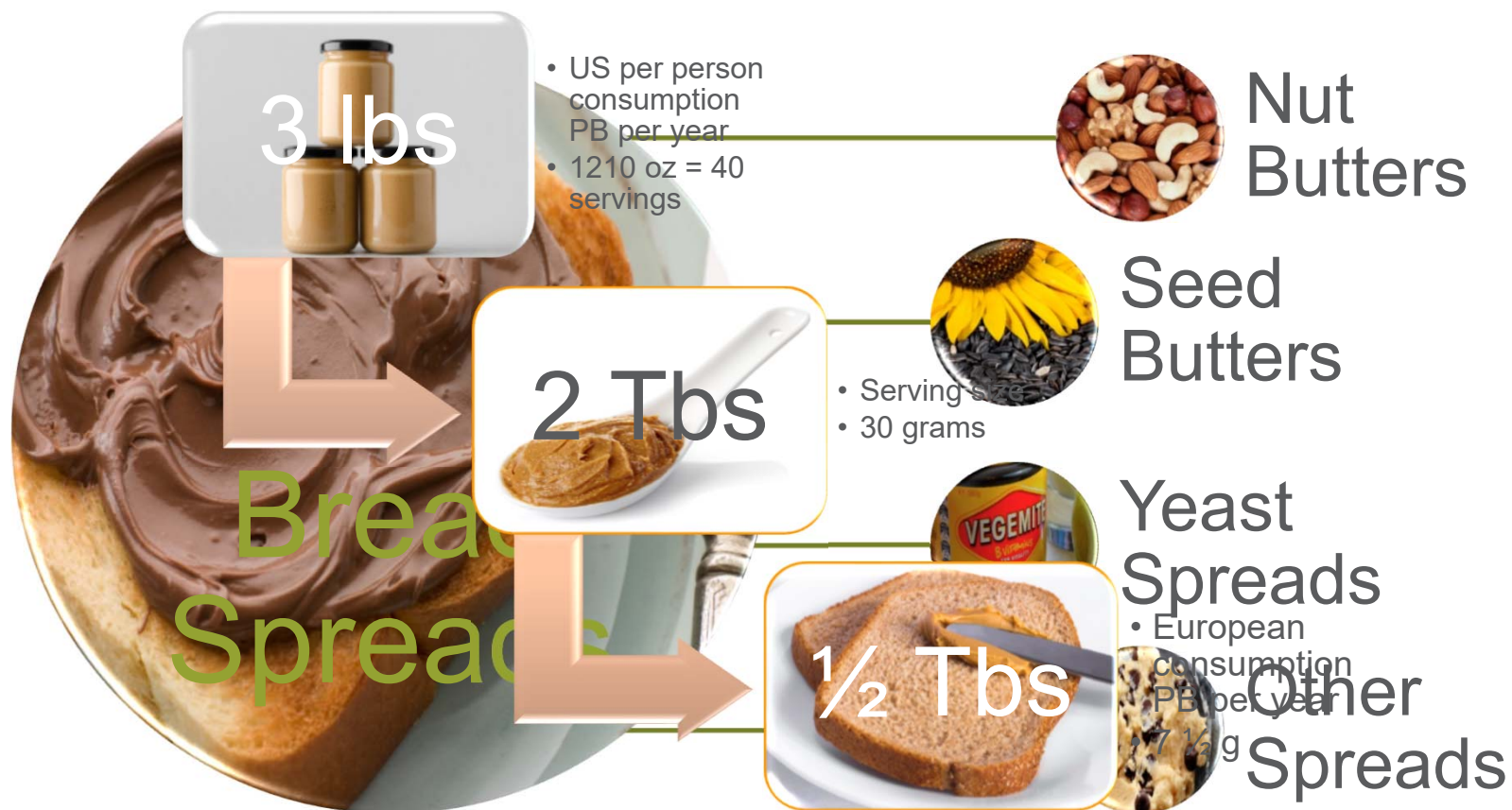




Who's Importing American Peanut Butter

Most important countries and regions for U.S. peanut butter exports 2017





Spread Samples



#	Type
1	Cookie
1	Multi
1	PB/Date
2	Almond
2	Cashew
2	Soybean
2	Tahini
2	Yeast
4	PB Powder
4	Sunbutter
5	Hazelnut
25	Peanut Butter

- Weighed into Silicone molds and flash frozen using liquid N₂
- 0.25 gm sample size



- Raisins were ground using SPEX SamplePrep Freezer Mill
- 0.25 gm sample size
- So why raisins?

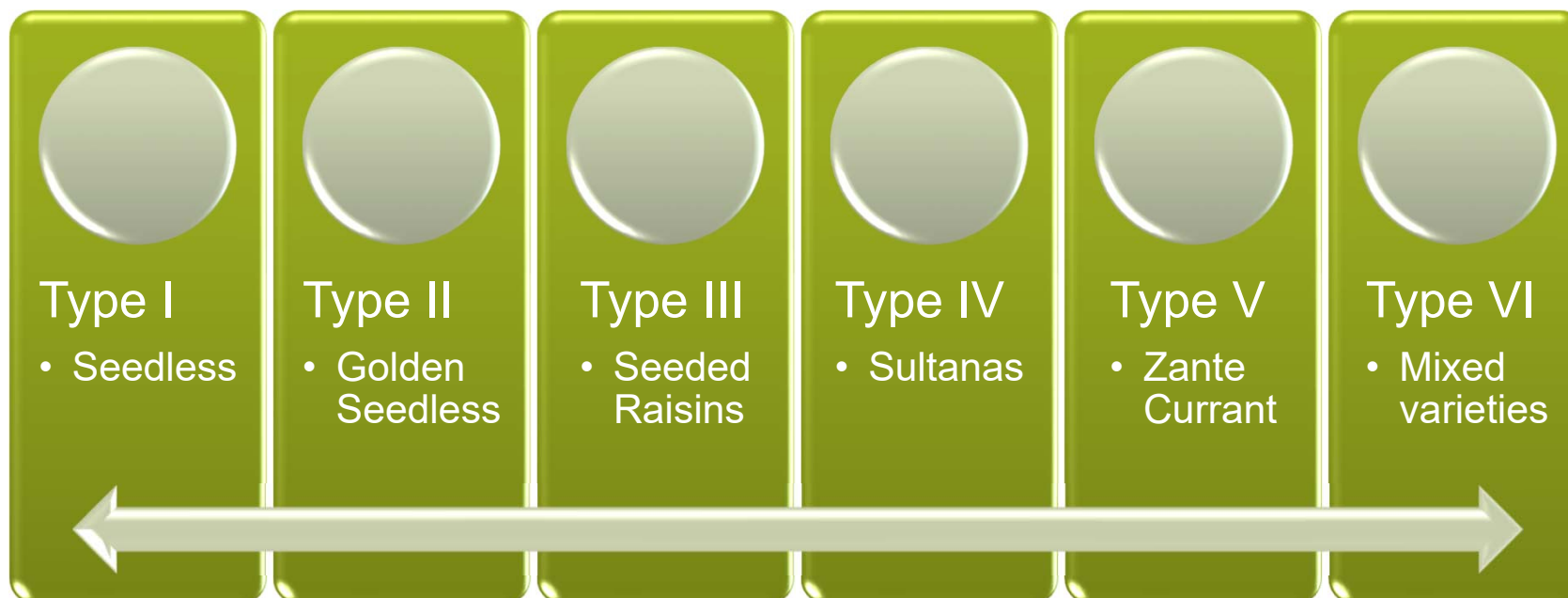


- Studies of pesticides & heavy metals:
 - *Grapes*
 - *Grape Juice*
 - *Wine*
- Jelly = pectin and sugar; so raisins instead
 - *4 tons of grapes = 1 ton of raisins*
 - *Global raisin production (2016)=1.2 million metric tons*
 - *US top producer 24% of the global harvest.*
 - Fresno, California is the Raisin Capital of the World.





#	Fruit
2	Cherry
5	Cranberry
3	Current
13	Raisin
4	Sultana



#	Fruit
2	Cherry
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3	Current
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4	Sultana

Digestion



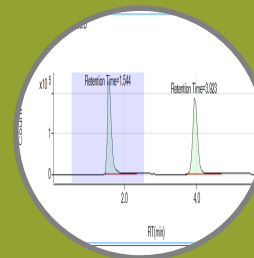
CEM Mars 6 with iWave
Xpress Plus Vessels
5 mL Sample
10 mL Nitric Acid
20 minute ramp to 200°C
15 min hold

Standards



SPEX CertiPrep Standards:
Multi-element CLMS Series 1-4

Analysis



PerkinElmer ICP-OES
Agilent ICP-MS 7900
Meinhard nebulizer
Cyclonic spray chamber
Analysis performed
No gas mode
Collision mode: Helium



Heavy Metal Limits (µg Daily/Adult)

Source	EPA	EPA	FDA	ATSDR
Route	Oral RfD	Drinking Water	Bottled Water	Oral
Daily limit	70 kg- Adult	µg/L	µg/L	70 kg- Adult
As	21	10	10	21
Cd	70	5	5	14
Pb	None	15	5	10
Hg	7	2	2	21

* Certain Species

Heavy Metal Limits (µg Daily/Child)

Source	EPA	EPA	FDA	CNHP	AHPA (2012)	ATSDR	USP <232>	Min	Max
Route	Oral RfD	Drinking Water	Bottled Water	Oral	Oral	Oral	Oral		
Daily limit	23 kg- Child (calculated)	2 (L)	2 (L)	23 kg- Child (calculated)	23 kg- Child (calculated)	23 kg- Child (calculated)	Daily		
As	7	7	7	3.3	3.3	7	15	3.3	15
Cd	23	3.3	3.3	2	1.4	5	5	1.4	23
Pb	None	10	3.3	7	2	3.33	5	2	10
Hg	2.3	1.3	1.3	7	0.66	7	30	0.66	30

* Certain Species

Sample #	ug/30g	As	Sr	Cd	Sb	Hg	Pb	Th	U
28	Peanut	0.79	63.69	1.86	0.16	0.23	0.74	0.06	1.15
29	Peanut	0.78	64.03	1.59	0.18	0.08	0.90	0.05	1.14
30	Peanut	0.84	67.93	1.95	0.23	0.00	0.80	0.07	1.18
31	Peanut	0.71	60.41	1.38	0.24	0.00	1.19	0.03	1.04
32	Peanut	0.56	71.08	2.63	0.15	0.00	1.00	0.03	1.02
33	Peanut	0.76	68.05	2.04	0.19	0.07	0.92	0.04	0.59
34	Peanut	0.92	73.15	1.52	0.11	0.16	0.95	0.04	0.62
34	Peanut	1.55	58.14	0.57	0.69	1.45	1.74	0.04	3.67
35	Peanut	0.62	65.09	1.70	0.21	0.03	1.52	0.07	0.59
36	Peanut	0.86	62.94	1.97	0.20	0.00	0.70	0.03	0.61
37	Peanut	0.37	66.32	1.48	0.13	0.03	0.68	0.01	0.59
38	Peanut	3.63	66.17	1.65	0.18	0.15	1.63	0.07	0.75
39	Peanut	0.70	71.17	1.89	0.35	0.07	0.82	0.04	0.68
40	Peanut	0.95	63.68	1.77	0.22	0.22	1.25	0.05	1.35
41	Peanut	0.74	58.13	1.42	0.14	0.13	1.87	0.06	0.82
42	Peanut	0.50	57.93	2.17	0.22	0.20	1.97	0.04	1.25
43	Peanut	0.48	73.70	3.31	0.16	0.22	0.94	0.03	1.47
44	Peanut	0.66	158.10	1.02	0.19	0.14	1.21	0.03	1.36
44	Peanut	0.92	87.16	22.52	0.77	0.58	1.22	0.01	2.29
45	Peanut	0.72	154.10	7.92	0.21	0.28	0.76	0.02	1.73
45	Peanut	1.44	202.81	10.63	0.46	0.81	1.43	0.02	2.74
47	Peanut	2.55	306.70	2.24	0.38	2.44	1.51	0.03	2.01
55	Peanut	1.06	531.38	0.87	0.23	0.29	0.74	0.01	2.43
56	Peanut	1.23	375.25	0.76	0.15	0.26	0.62	0.07	2.07
76	Peanut	1.22	117.91	2.45	0.28	0.32	4.54	0.10	2.60
46	Peanut/Date	1.40	331.39	1.58	0.13	0.19	0.81	0.19	1.28
70	Peanut Powder	1.55	956.35	5.88	0.11	0.52	0.68	0.03	1.44
71	Peanut Powder	1.12	85.35	1.32	0.16	0.25	1.21	0.04	1.67
72	Peanut Powder	1.93	150.37	0.12	0.25	0.15	1.10	0.04	1.67
73	Peanut Powder	2.96	206.55	0.14	0.13	0.01	0.73	0.06	1.57
ADL min		10.00		4.00		2.00	5.00		
ADL max		20.00		70.00		30.00	30.00		
Child ADL min		3.00		1.40		0.66	2.00		
Child ADL max		15.00		23.00		30.00	10.00		

- Most PB low in heavy metals
 - Highest As – 3 ug
 - One very high in Cd 22.5 ug (98% ADL)
 - Sr - 956

Sample #	ug/30g	As	Sr	Cd	Sb	Hg	Pb	Th	U
57	Almond	2.98	448.56	1.06	0.91	1.16	3.59	0.02	9.23
60	Cashew	3.56	140.61	0.76	0.99	0.95	2.97	0.01	8.87
64	Cashew	2.38	91.51	0.67	1.01	0.73	3.15	0.02	8.01
65	Hazelnut	1.11	118.46	2.25	0.72	1.56	1.7	0.05	4.01
66	Hazelnut	6.44	127.04	1.03	0.96	1.39	5.48	0.06	8.79
67	Hazelnut	2.85	83.44	0.62	0.92	1.87	2.89	0.06	7.71
68	Hazelnut	2.79	92.15	1.49	0.89	1.54	4.39	0.05	8.06
69	Hazelnut	1.45	58.21	1.08	0.37	0.8	2.7	0.12	2.87
48	Multi	0.64	49.47	2.68	0.2	0.26	0.62	0.02	1.79
63	Cookie	3.06	12.79	0.81	0.81	1.26	2.6	0.02	7.59
61	Soybean	2.2	1132.38	0.91	0.55	1.37	3.41	0.04	4.06
62	Soybean	1.66	14.95	0.6	0.49	0.98	1.5	0.01	3.12
49	Sunflower	1.77	79.54	17.66	0.57	1.42	5.93	0.01	4.09
52	Sunflower	1.35	125.66	3.36	0.74	0.69	1.43	0.03	2.37
53	Sunflower	0.91	75.26	7.67	0.61	0.59	1.31	0.01	2.53
54	Sunflower	5.25	205.44	0.52	3.18	0.78	3.82	0.03	2.12
58	Tahini	1.15	417.83	0.87	0.45	0.97	1.14	0.01	3.11
59	Tahini	1.16	408.07	0.35	0.39	0.88	1.37	0.04	2.78
74	Yeast	5.41	123.66	0.6	0.79	0.95	1.61	0.03	2.59
75	Yeast	0.66	156.96	1.13	0.4	0.48	1.77	0.02	2.19
ADL min		10		4		2	5		
ADL max		20		70		30	30		
Child ADL min		3		1.4		0.66	2		
Child ADL max		15		23		30	10		

- Tree nut butters highest in Heavy metals & U
- Hazelnut 6.4 ug -43% ADL
- Sunflower 17.7 ug Cd – 77% ADL & 5.9 ug Pb – 59% ADL
- Hg levels slightly higher in nut butters and seed butters than in PB

Sample #	ug/30g	As	Sr	Cd	Sb	Hg	Pb	Th	U
1	Raisin	1.17	1031.95	2.90	0.25	0.34	1.21	0.02	1.60
2	Raisin	3.46	238.00	0.23	0.44	34.63	1.10	0.04	10.43
3	Raisin	3.02	153.38	0.18	0.28	0.91	1.43	0.21	11.07
4	Raisin	1.11	122.82	0.10	0.22	0.89	1.07	0.12	11.13
5	Raisin	3.13	247.46	2.19	0.23	0.47	1.75	0.56	1.26
6	Raisin	3.10	207.11	0.16	0.26	0.47	0.90	0.16	2.39
7	Raisin	3.71	134.24	0.19	0.37	0.34	3.11	0.27	39.76
8	Raisin	1.74	108.18	0.27	0.23	0.40	0.99	0.05	2.55
9	Cherry	0.73	48.65	0.09	0.18	0.17	0.59	0.01	1.25
10	Cherry	2.49	2556.52	0.29	0.40	0.32	2.34	0.02	36.26
11	Sultana	4.29	192.82	0.27	0.40	0.66	4.98	0.28	61.57
12	Sultana	4.23	212.17	0.21	0.31	0.41	4.27	0.11	39.32
13	Sultana	4.23	95.54	0.19	0.30	0.64	4.21	0.09	47.18
14	Sultana	5.15	126.73	0.24	0.29	0.27	4.27	0.19	58.43
15	Raisin	3.59	70.65	0.27	0.30	0.35	2.49	0.07	34.66
16	Raisin	2.04	300.42	0.07	0.19	1.21	1.80	0.14	4.71
17	Raisin	3.41	103.21	0.14	0.23	0.23	1.95	0.12	67.50
18	Raisin	3.19	162.65	0.10	0.21	0.11	1.12	0.29	12.13
19	Raisin	1.83	156.96	0.14	0.26	0.18	0.90	0.08	13.08
20	Cranberry	3.93	6.48	0.45	0.55	0.28	4.30	0.02	43.34
21	Cranberry	4.39	13.41	0.42	0.34	0.40	4.55	0.01	56.33
22	Cranberry	0.99	11.83	0.23	0.27	0.32	1.31	0.01	2.40
23	Cranberry	3.80	6.85	0.45	0.49	0.25	3.99	0.01	32.38
24	Cranberry	2.77	176.64	0.10	0.30	0.18	2.51	0.17	29.22
25	Current	3.36	157.35	0.18	0.48	0.26	3.47	0.06	37.54
26	Current	5.75	389.24	0.36	0.44	0.73	5.52	0.35	62.61
27	Current	0.84	1725.86	0.19	0.25	0.64	0.87	0.02	2.29
50	Peanut/Jelly	1.06	165.98	8.96	0.28	0.31	1.48	0.12	1.75

ADL min	10.00	4.00	2.00	5.00
ADL max	20.00	70.00	30.00	30.00
Child ADL min	3.00	1.40	0.66	2.00
Child ADL max	15.00	23.00	30.00	10.00

- 5.5 ug Pb in Current – 50% ADL
 - 62.6 ug
 - 5.75 ug As (38% ADL)
- PBJ candy = 9 ug Cd 39% ADL
- Raisin 34.6 ug Hg 120% ADL

- 2 Tbs Nut Spread (Hazelnut @ 5 ug Pb, 6.5 As)
 - Total 10 ug Pb - @ ADL
 - Total 13 ug As 87% ADL
- Sunflower spread 18 ug Cd & PB Candies 9 ug = 27 ug – 117%



- Carlye McDonnell, SPEX CertiPrep
- Bob Lockerman, CEM
- Tina Restivo, CEM

Thank You!
Questions?