

Heavy Metals in Products Containing Boba (Tapioca Pearls)

GOALS

To gauge the levels of heavy metals, particularly lead, in boba (tapioca pearls) and tea containing boba, and to inform the public about any health concerns and safer options available.

TEST APPROACH AND METHODS

At least three samples of each model were sent to a certified lab for total cadmium, lead, mercury, and arsenic testing using Inductively Coupled Plasma – Triple Quadrupole Mass Spectrometry (ICP-QQQ MS) according to method AOAC 2015.01 Modified. For the two models of tea purchased at tea shops, the boba was separated from the liquid portions of the teas by decanting off the liquid. The boba and liquid were shipped in ice to the laboratory so each component could be tested separately.

DATA ANALYSIS

To estimate the average concentration of a heavy metal in a tested model, we applied a method used by many risk assessors,¹ including the Environmental Protection Agency.² If a heavy metal was detected (greater than the method detection limit, or MDL) in any of the samples tested of the model, the samples that had test results below the MDL were assumed to have a concentration of half the MDL for that heavy metal. If the heavy metal was not detected in any of the samples tested of the model, we assumed a concentration of zero for all the samples of that model for the heavy metal. This approach to risk assessment appropriately considered important uncertainties about potential levels of undetected risk in samples with test results below the MDL.

EXPOSURE ASSESSMENT

We determined the estimated intake of lead, total arsenic, and total mercury per serving of each product. (Cadmium was not detected in any tested boba or tea.)

We used several published health-based exposure limits to inform our assessment (see the table on the next page).

To assess the risk from lead posed by the products, CR used the California Office of Environmental Health Hazard Assessment (OEHHA) Maximum Allowable Dose Levels (MADL) as the benchmarks for CR's levels of concern. MADLs are levels established through California's Proposition 65 law. CR uses these values because the standards are the most protective available. A CR level of concern >100 percent would indicate that consumption of one serving per day would pose a comparatively higher health risk.

However, while we use the MADLs involved in Prop 65, we approach our exposure assessment differently from what's outlined in Prop 65. Prop 65 takes into consideration consumers' average exposure over time and dietary frequency to calculate whether a product exceeds the MADL and requires a warning label. By contrast, Consumer Reports assumes one serving a day of the product in its risk assessment calculations. This difference in methodology means no Prop 65 judgments can be made from CR's findings. Our results are meant to provide guidance on which products have comparatively higher levels of lead, not to identify the point at which lead exposure will have measurable harmful health effects, or to assess compliance with California law.

We also determined the estimated intake of lead as a percentage of the Food and Drug Administration's interim reference level (IRL) for children and women of childbearing age, which is a less protective risk level than the MADL.

For arsenic and mercury, we estimated a 75-kilogram (165-pound) adult's intake and a 20-kilogram (44-pound)

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¹ Xue, J., Zartarian, V., Wang, S., et al., Probabilistic Modeling of Dietary Arsenic Exposure and Dose and Evaluation with 2003-2004 NHANES Data, Environmental Health Perspectives, 118, no. 3 (2010): 345-50. ([Link](#))

² Regional Guidance on Handling Chemical Concentration Data Near the Detection Limit in Risk Assessments, Environmental Protection Agency. ([Link](#))

6-year-old child's intake of the tested total arsenic and total mercury from a serving of each product and compared the intake estimate to the exposure limit for inorganic arsenic and methylmercury in the table at right.

Noncancer exposure risks were calculated by the Hazard Quotient Method³ and the following equation for arsenic and mercury:

$$HQ = \text{Exposure Dose} / \text{Reference Dose}$$

An HQ >1 (for arsenic and mercury) or %MADL >100 (for lead) would indicate that consumption of one serving per day would be of health concern. Arsenic was measured in three models and mercury was measured in two models, but not at levels CR would consider to be a health concern. Inorganic arsenic and methylmercury

were not measured because total arsenic and total mercury levels were not high enough to pose a health risk based on CR's risk assessment for a person 6 years or older consuming up to two servings per day.

Health-Based Exposure Limits Informing Exposure Assessments for Selected Heavy Metals

Heavy Metal	EPA RfD, mcg/kg bw/d	OEHHA MADL, mcg/day
Inorganic Arsenic	0.06 ⁴	NA
Lead	NA	0.5 ⁵
Methylmercury	0.1 ⁶	NA

OEHHA = California Office of Environmental Health Hazard Assessment.
MADL = Maximum Allowable Dose Level.
RfD = Oral Reference Dose.
NA = Not applicable.

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³ "Risk Assessment for Other Effects," Environmental Protection Agency. [\(Link\)](#)

⁴ U.S. Environmental Protection Agency Integrated Risk Information System (IRIS) Chemical Assessment Summary, Arsenic, inorganic. [\(Link\)](#)

⁵ State of California, OEHHHA, Lead. [\(Link\)](#)

⁶ The EPA has not established an oral reference dose (RfD) for total mercury, therefore, the RfD for methylmercury is used to estimate risk. [\(Link\)](#)

Boba Products

CR tested boba (tapioca pearls) in four products for arsenic, cadmium, lead, and mercury. The products are listed in alphabetical order. The values for arsenic, lead, and mercury are given in micrograms (mcg) for one serving of the product and in parts per billion (ppb). Cadmium was not detected in any of the products. The levels listed for the tea shop drinks are for the boba portion of the drinks only.

Product	Serving Size	Total Arsenic (mcg) ¹	Total Arsenic (ppb) ¹	Lead (mcg)	Lead (ppb)	Total Mercury (mcg) ¹	Total Mercury (ppb) ¹
Gong Cha Pearl Milk Tea (tapioca pearls only)	87 grams ²	0.26	3.0	0.35	4.0	ND	ND
Kung Fu Tea Milk Tea with Boba (tapioca pearls only)	87 grams ²	ND	ND	0.32	3.6	ND	ND
Trader Joe's Instant Boba Kit ³	1 pouch (65 grams)	1.06	16.2	0.42	6.4	0.04	0.6
WuFuYuan Tapioca Pearl, Black Sugar Flavor	1/3 cup (50 grams) ⁴	0.15	3.0	0.15	2.9	0.030	0.6

ND = Not detected.

¹ Inorganic arsenic and methylmercury were not measured because total arsenic and total mercury levels were not high enough to pose a health risk based on CR's risk assessment for a person 6 years or older consuming up to two servings per day.

² Approximate weight of tapioca pearls in a 24-ounce cup of tea.

³ This product has been discontinued by the manufacturer, but consumers may still have this product in their freezers.

⁴ Uncooked weight; prepared weight is 70 grams, just slightly more than 1/3 cup.