

Dioxin in Ben & Jerry's Ice Cream

By Michael Gough and Steven J. Milloy*

Summary:

A sample of Ben & Jerry's "World's Best Vanilla"® ice cream was tested for the presence of 2,3,7,8-tetrachlorodibenzo-p-dioxin and related chemicals ("dioxin") by an independent laboratory. On a total weight basis, the sample tested had 0.79 ± 0.38 parts per trillion (ppt) Toxic Equivalents (TEQ) of dioxin. The concentration of dioxin in the sample's lipids was 5.1 ± 1.3 ppt TEQ. Ben & Jerry's Homemade Holdings, Inc. states in promotional literature that "The only safe level of dioxin exposure is no exposure at all." Assuming the measurement is correct and sample tested is representative of Ben & Jerry's ice cream and based on U.S. Government information about the potential health effects of dioxin, Ben & Jerry's ice cream may cause about two hundred of cases of cancer among its consumers.

Introduction:

Polychlorinated dioxins and furans, hereinafter referred to as "dioxin" or "dioxins," are ubiquitous compounds that have generated much controversy because of their great toxicity in laboratory animal experiments. Dioxin has been called "the most deadly compound ever assembled by man."¹ Ben & Jerry's Homemade Holdings, Inc. ("Ben & Jerry's") states in promotional literature that "The only safe level of dioxin exposure is no exposure at all."² We had a sample of Ben & Jerry's "World's Best Vanilla"® ice cream tested for the presence of dioxin.

Methods:

A pint of Ben & Jerry's "World's Best Vanilla"® ice cream was purchased in Montgomery County, Maryland, packed in dry ice and shipped overnight to Xenobiotic Detection Systems, Inc. ("XDS"), Durham, North Carolina.

XDS has a genetically engineered mouse hepatoma cell line that contains the firefly luciferase gene under trans-activational control of the aryl hydrocarbon receptor (AhR), which can be used for the detection and relative quantitation of AhR agonists, such as dioxin. XDS employed its *in vitro* assay, the Chemical-Activated Luciferase Expression or CALUX™, to test for the presence of dioxin in the ice cream sample.

Monolayers of H1.L.1.6 mouse hepatoma cells³ grown in 96 well culture plates were exposed to the ice cream and ice cream lipid samples, and incubated for 24 hours in a humidified carbon dioxide incubator. Additionally, a standard curve of TCDD concentrations was assayed (128.8, 64.4, 32.2, 16.1, 8.0, 4.0, 2.0, 0.5 and 0.2 parts per trillion (ppt) TCDD). All assays of standards and unknowns were run in

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duplicate. Following the incubation, the media was removed and the cells were microscopically observed for viability, which were unaffected by exposure to the samples. The luciferase assay was run to quantify the concentrations of TEQ⁴ dioxin.

Results:

The concentrations of dioxin in the ice cream sample and in lipid fractions from the same ice cream are shown in Table 1. Based on either measurement, the calculated amount of dioxin consumed in a single serving of the ice cream is about 80 picograms (pg, one trillionth of a gram).

Table 1.
Concentrations of Dioxin in Sampled Ice Cream and
Exposure to Dioxin from One Serving

Sample	Concentration of dioxin, ppt TEQ	Weight of ice cream, single serving (grams)	Weight of dioxin, single serving (picograms)
Ice cream	0.79±0.38	107 ^a	84
Ice cream lipids	5.1±1.3	16 ^a	82

a - From information on the ice cream package.

Discussion:

Our sample of Ben & Jerry's "World's Best Vanilla"® ice cream tested positive for the presence of dioxin. This may be alarming since, as Ben & Jerry's states, "The only safe level of dioxin exposure is no exposure at all." The U.S. Environmental Protection Agency (EPA) agrees with that statement, and holds the view that any exposure, no matter how small, increases the risk of cancer.

The EPA has calculated a "virtually safe dose" (VSD) for dioxin, which is the exposure to dioxin associated with one additional case of cancer per million people exposed on a daily basis over their lifetimes. The VSD is generally regarded as an acceptably low exposure. For dioxin, the VSD is 0.006 pg TEQ/kilogram body weight/day (pg/kg bw/d).⁵ The amount of dioxin in a serving of the tested ice cream is about 80 pg TEQ/serving (see Table 1) and exceeds the VSD.

To calculate the dose rate of dioxin from the tested ice cream, we assume the average consumer weighs 70 kilograms (kg). The dose rate of dioxin from one serving of the tested ice cream is 1.14 pg TEQ/kg bw/day.⁶ This dose rate is 190 times greater than the EPA's VSD, meaning that 190 dioxin-caused cancers may be expected among every million people who consume that amount of ice cream on a daily basis.

We calculated the number of dioxin-caused cancers that might occur in people who consume Ben & Jerry's ice cream. We assumed that our measurement of dioxin is correct and that it is representative of all Ben & Jerry's ice cream manufactured and that all the ice cream manufactured is consumed. We assumed that, consistent with Ben & Jerry's promotional literature and EPA policy, dioxin causes cancer and that there is no safe level of exposure to dioxin.

According to the company, Ben & Jerry's manufactures 13 million gallons of ice cream per year.⁷ This equals 416 million servings of Ben & Jerry's ice cream per year.⁸

If consumers eat one serving of Ben & Jerry's ice cream per day, the number of daily consumers is 1.1 million.⁹ Under the aforementioned assumptions, an additional 209 cases of cancer may be expected among those people over a 70-year lifetime.¹⁰

Because of the assumption that there is no safe level of dioxin consumption, reducing the amount of ice cream consumed does not decrease the number of estimated cancer cases on a population basis. It does, however, reduce the risk for individual consumers. See Table 2.

Table 2.
Estimated Cancer Risks from Dioxin in Ben & Jerry's Ice Cream

Frequency of consumption of ice cream servings	Number of consumers ^a	Times in excess of EPA VSD for dioxin ^b	Number of cancer cases	Lifetime risk of cancer per consumer
Daily	1.1 million	190	209	1.9 x 10 ⁻⁴
Every other day	2.2 million	95	209	0.95 x 10 ⁻⁴
Every 4 th day	4.4 million	47.5	209	0.47 x 10 ⁻⁴
Every 10 th day	11 million	19	209	0.19 x 10 ⁻⁴
Every 100 th day	111 million	1.9	209	0.02 x 10 ⁻⁴

a - The number of consumers required to eat the 1.1 million daily servings goes up as the frequency of consumption goes down.

b - The exposure of someone who eats ice cream every other day is one-half the exposure of the daily consumer and so forth. Therefore, her dose, expressed as a multiple of the VSD, decreases by one-half also.

The study has two major weaknesses. First, we were able only to test one sample of ice cream. This sample may or may not be representative of all Ben & Jerry's ice cream. There is measurement error associated with our sample. Concentrations of dioxin in Ben & Jerry's ice cream may be greater or less than measured in our sample. Variation in the levels of dioxin would either raise or lower the risk estimates presented here. However, our results are consistent with previous findings.¹¹

Second, we do not believe that credible scientific evidence exists to conclude that dioxin causes cancer in humans. Studies of populations exposed to high levels of dioxin as a result of the industrial explosion at Seveso, Italy¹² and participation in the U.S. Air Force Ranch Hand project during the Vietnam War (spraying Agent Orange)¹³ do not support the hypothesis that dioxin is a human carcinogen.

Conclusion:

Ben & Jerry's states in promotional literature that "The only safe level of dioxin exposure is no exposure at all." An independent laboratory measured dioxin in Ben & Jerry's "World's Best Vanilla"® ice cream. Assuming the measurement is correct and that it is representative of Ben & Jerry's ice cream, and based on U.S. Government information about the potential health effects of dioxin, Ben & Jerry's ice cream may cause about two hundred of cases of cancer among its consumers.

Endnotes:

1. United Press International. 1983. "Dioxin — A Ticking Time Bomb 170,000 Times As Deadly As Cyanide," March 11, 1983.
2. Ben & Jerry's Holdings, Inc. 1999. "Our Thought On Dioxin" (brochure).
3. U.S. Patent #5,854,010.
4. "TEQ" is Toxic Equivalency. Dioxins occur as mixtures. To facilitate assessment of mixtures of dioxins, various dioxin and furan compounds have been assigned "toxic equivalency factors" (TEFs) based on their toxic potency relative to that of the most toxic dioxin, 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). In combination with concentrations of the various dioxin compounds, TEFs can be used to calculate the TEQ - a quantification of the various dioxin compounds as if they were all TCDD.
5. U.S. EPA. 1985. Health Assessment Document for Chlorodibenzo-p-dioxins (EPA600/8-84-014A).
6. 80 pg TEQ x person/70 kg bw.
7. Correspondence from Ben & Jerry's.
8. 13 million gallons year x 8 pints per gallon x 4 servings per pint.
9. 416 million servings per year divided by 365 days per year.
10. Daily consumers (1.1 million) x 190 cancer/million exposed people.
11. Schecter, A et al. 1994. "Congener-specific levels of dioxins and dibenzofurans in U.S. food and estimated daily dioxin toxic equivalent intake." *Environmental Health Perspectives* 102:962-966.
12. Bertazzi, PA et al. 1997. "Dioxin exposure and cancer risk. A 15-year mortality study after the Seveso accident." *Epidemiology*, 8:646-652.
13. See Institute of Medicine. 1996 Veterans and Agent Orange, Update 1996. National Academy Press.