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March 12, 1997

Mr. William J. Greim
ATSDR - DHAC
1600 Clifton Rd. N.E.
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Dear Bill:

Attached is a draft health consultation regarding re-evaluation of the fish consumption advisory on the Brazos River near Freeport in Brazoria County, Texas. This consultation was requested by the Department's Seafood Safety Division. We have provided that Division a copy for their convenience. Please let us know when you have completed your certification process.

Sincerely,

Nancy B. Ingram
Public Health Technician
Health Risk Assessment and Toxicology Program

Attachment

TEXAS DEPARTMENT OF HEALTH
Austin Texas
INTER-AGENCY MEMORANDUM

TO: Kirk Wiles, R.S., Assistant Director
Seafood Safety Division

THRU: Jean Brender, R.N., Ph.D., Director
Division of Noncommunicable Disease Epidemiology & Toxicology

THRU: John F. Villanacci, Ph.D., Director
Health Risk Assessment and Toxicology Program

FROM: Lisa R. Williams, M.S., Toxicologist
Health Risk Assessment and Toxicology Program

DATE: March 12, 1997

SUBJECT: Re-evaluation of the fish consumption advisory on the Brazos River

Attached is the draft health consultation you requested to re-evaluate the fish consumption advisory on the Brazos River near Freeport. This document has been forwarded to the Agency for Toxic Substances and Disease Registry for their certification. When we receive the certified document, we will provide a copy to you for your records.

HEALTH CONSULTATION

BRAZOS RIVER NEAR FREEPORT

Freeport, Brazoria County, Texas

MARCH 12, 1997

Prepared by

Texas Department of Health
Under Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

BACKGROUND AND STATEMENT OF ISSUES

The Texas Department of Health (TDH) Seafood Safety Division (SSD) has requested that the TDH Health Risk Assessment and Toxicology Program evaluate the potential human health risks associated with consumption of seafood taken from an approximate thirty mile stretch of the Brazos River in Brazoria County between Lake Jackson and Freeport, Texas. This section of the River has been under a fish consumption advisory since September of 1990 due to contamination of fish with chlorinated dibenzo-p-dioxins and dibenzofurans (dioxin) associated with releases from the Dow Chemical Corporation (DOW) near Freeport. This advisory recommends that no more than one meal, not to exceed eight ounces, be consumed each month; in addition, women of child bearing age, and children were advised not to consume fish from this area.

Since the advisory went in effect, Dow has modified their processes to reduce the amount of dioxin discharged to the Brazos River and has recently requested that the TDH re-evaluate the consumption advisory issued in 1990. The 1996 dioxin levels in seafood collected from this area are significantly lower than levels reported in 1990.

DISCUSSION

In 1986, as part of a National Bioaccumulation Study of dioxin contaminated soil, water, sediment, air, and fish, the U.S. Environmental Protection Agency (EPA) found high concentrations of dioxin in fish and shellfish in eleven sites within EPA's Region 6. These sites were downstream of bleach kraft pulp and paper mill discharges [1]. Three fish samples obtained from the Brazos River downstream of DOW by EPA and DOW in 1990 showed dioxin levels between 13 and 37 parts per trillion (ppt). On September 19, 1990, as a result of this study, the TDH issued advisories for three areas of Texas, including the Brazos River south and east of the FM 521 bridge to the mouth of the river on the Texas Gulf Coast.

Following issuance of the advisory, the Texas Water Commission (predecessor of the Texas Natural Resource Conservation Commission) required DOW to routinely monitor aquatic life and water for dioxins and furans as part of their discharge permit requirement. Processes at DOW also were known to produce hexachlorobenzene as an unwanted impurity, causing bioaccumulation of this chemical in aquatic life. The DOW Technical Solutions Team was formed to implement measures to minimize releases of dioxins and hexachlorobenzene to the Brazos River.

In January and April of 1996, the SSD collected 59 seafood samples, consisting of 49 finfish and 10 crab samples from the DOW discharge area. These samples were analyzed for dioxins, pesticides, metals, semi-volatile and volatile organic chemicals (Table 1). Twenty four samples of fish and crabs indicate that the Toxicity Equivalent Concentration (TEC) for dioxins and furans has been reduced to 1.05 ppt. The major contributors to the TEC are pentachlorodibenzofurans.

TABLE 1 SUMMARY OF RESULTS FOR 1996 BRAZOS RIVER SAMPLES				
CHEMICAL	AVERAGE CONCENTRATION	No. Samples Affected	Range	Detection Limit
Dioxins and Furans	1.05 ppt TEC*	21/24	nd-4.14	NA
PESTICIDES				
DDE	12 ppb	22/40	nd-69	5
Hexachlorobenzene	31 ppb	30/40	nd-150	2
Pentachlorobenzene	1.7 ppb	14/40	nd-13	2
POLYCHLORINATED BIPHENYLS				
PCB (Aroclor 1254)	9.1 ppb	3/40	nd-73	40
VOLATILE ORGANIC CHEMICALS				
1,2,3-Trichloropropane	24.5 ppb	15/40	nd-206	20
2-Butanone (mek)	13.8 ppb	4/40	nd-177	20
Bromoform	1.5 ppb	2/40	nd-30	20
1,2-Dichloropropane	1.8 ppb	2/40	nd-50	20
Benzene	0.8 ppb	1/40	nd-33	20
Dibromomethane	1.4 ppb	1/40	nd-57	20
Dibromochloromethane	1.05 ppb	2/40	nd-21	20
Chloroform	0.6 ppb	1/40	nd-24	20

*The overall dioxin concentration (Toxicity Equivalency Concentration) is obtained by using toxic equivalency factors for the various dioxins and furans to normalize them to the toxicity of 2,3,7,8-tetrachlorodibenzodioxin (2,3,7,8-TCDD) the most toxic dioxin isomer.

Toxicological Evaluation

To evaluate non-carcinogenic health effects, an estimated dose was calculated from the average concentration of each compound and compared to an EPA Reference Dose (RfD). The RfD is an estimate of daily human exposure to a contaminant that is unlikely to cause non-cancer adverse health effects over a lifetime. An average consumption of 30 grams per day, or approximately one 8 oz meal per week, was used to estimate exceedance of the reference dose. This average represents an estimate of the average consumption of fish and shellfish from marine and fresh waters by the 50th percentile of recreational fishers [2]. The RfDs for chronic oral exposure were not exceeded for any of the compounds detected in fish from the Brazos River near DOW.

Six of the chemicals analyzed in fish and crabs downstream of DOW are associated with a theoretical excess lifetime cancer risk with continued exposure. Only those contaminants which are considered probable or known human carcinogens were considered in this evaluation. Assuming an exposure period of 30 years, a body weight of 70 kg, and an average consumption rate of 30 grams per day, the theoretical excess lifetime cancer risk is estimated to be 8×10^{-5} (Table 2).

TABLE 2 POTENTIAL CARCINOGENS DETECTED IN BRAZOS RIVER SEAFOOD	
Compound	Carcinogenic Risk*
Dioxins and Furans	7×10^{-5}
DDE	7×10^{-7}
Hexachlorobenzene	9.1×10^{-6}
Benzene	4.3×10^{-9}
Bromoform	2.2×10^{-9}
Chloroform	6.7×10^{-10}
OVERALL RISK	8×10^{-5}

*Assumes a consumption level of 30 grams per day, a body weight of 70 kg, and an exposure period of 30 years

Contaminants Evaluated

Dioxin

In 1985 the EPA classified dioxins and furans as Group B2, probable human carcinogens. This means that although evidence of carcinogenicity in humans is inadequate, there are sufficient animal carcinogenicity data to consider dioxin a probable human carcinogen. The quantitative cancer slope factor that the EPA currently lists in the Health Effects Summary Tables (HEAST) is 1.56×10^5 (mg/kg/day)⁻¹. This is based on increased incidence of liver tumors in animals exposed experimentally; however, this risk estimate is currently being reevaluated by the EPA [3]. The overall dioxin concentration is obtained by using toxic equivalency factors for the various dioxins and furans to normalize them to the toxicity of 2,3,7,8-tetrachlorodibenzodioxin (2,3,7,8-TCDD), the most toxic dioxin isomer.

DDE

DDE is a breakdown product of DDT, which was commonly used as a pesticide until its banning by EPA in 1972. It is an extremely persistent compound that was found at low levels in 99% of all sites investigated in the EPA "National Study of Chemical Residues in Fish" [4]. DDE is classified as a Group B2, probable human carcinogen and is associated with a quantitative cancer slope factor of 0.34 (mg/kg/day)⁻¹ based on increased incidence of liver neoplasms in mice and rats exposed to high levels of the compounds. Studies of workers exposed to DDT do not indicated conclusively an association between DDT exposure and the development of cancer in humans [5].

Although DDE was found in over half the fish samples collected from the Brazos River, the levels detected are considered insignificant in terms of the potential for adverse health effects.

Hexachlorobenzene

Hexachlorobenzene (HCB) is formed as a by-product during the manufacture of chemicals used as solvents, chlorine containing compounds, and pesticides. Small amounts of HCB can also be produced during combustion processes such as burning of city wastes. Hexachlorobenzene is classified as a Group B2, probable human carcinogen and is associated with a quantitative cancer slope factor of $1.6 \text{ (mg/kg/day)}^{-1}$ based on increased incidence of carcinoma of the liver, thyroid, and kidney in three rodent species [6]. In hamsters, HCB doses of $4\text{-}16 \text{ (mg/kg/day)}^{-1}$ produced hematomas and thyroid cancers. Significant incidence of renal adenomas, hepatocarcinomas, and lymphosarcomas were found in a 90 day feeding study with hamsters at a dose level of $17 \text{ (mg/kg/day)}^{-1}$. Reported epidemiological studies of HCB have not been designed to measure increases in cancer incidence in humans as an endpoint and therefore are inadequate in this context [3].

Benzene

One of the forty fish collected from the Brazos River contained 33 ppb benzene (detection limit=20 ppb). The carcinogenic risk associated with benzene in fish from the Brazos River is negligible. Benzene is commonly found in the environment as a result of industrial processes such as coal burning, motor vehicle exhaust, evaporation from gasoline service stations, and use of industrial solvents. Benzene is classified as a Group A, known human carcinogen, with a quantitative cancer slope factor of $0.029 \text{ (mg/kg/day)}^{-1}$. This is based on positive evidence for carcinogenicity, including leukemia and liver neoplasms in animal studies [7].

Bromoform and Chloroform

These compounds are chemically classified as trihalomethanes and are commonly formed from the interaction of chlorine with organic material found in water. The carcinogenic risk associated with the average concentration of these compounds in fish from the Brazos river is negligible. Bromoform is classified as a Group B2 carcinogen, with an oral slope factor of $0.0079 \text{ (mg/kg/day)}^{-1}$ and chloroform is classified as a Group B2 carcinogen with an oral slope factor of $0.0061 \text{ (mg/kg/day)}^{-1}$ [3].

Overall Carcinogenic Risk

All six of the chemicals discussed are classified as Group A or B2, probable human carcinogens, based on increased incidence of hepatic carcinoma in laboratory animals. Persons consuming fish from this area may be exposed to a number of these chemicals simultaneously. Since each of these chemicals is capable of inducing the same health effect, the risk is considered additive for all six. Using the cancer slope factors developed by the EPA and a 30 year exposure scenario, a 70 kg adult consuming 30 grams a day of seafood from the Brazos River near Freeport would be exposed to a 8×10^{-5} risk level. The level of consumption required to exceed the 1×10^{-4} risk level is 35 grams per day. For carcinogenic chemicals, the Texas Department of Health recommends that consumption be limited to amounts that result in an estimated excess theoretical lifetime cancer risk of less than 1×10^{-4} .

CONCLUSIONS

1. The levels of dioxin detected in fish from the advisory area of the Brazos River have decreased significantly between 1990 and 1996.
2. The RfDs for chronic oral exposure were not exceeded for any of the compounds detected in fish from the advisory area of the Brazos River. Thus, adverse non-carcinogenic health effects are not likely.
3. Based on the 1996 data, the overall theoretical excess cancer risk for persons consuming one 8 oz. meal per week of fish from the advisory area of the Brazos River is estimated to be 8×10^{-5} . Qualitatively this risk can be interpreted as a low apparent increased risk for cancer over a lifetime of exposure.

RECOMMENDATIONS

1. Continuation of the Brazos River fish consumption advisory issued in 1990 should be re-evaluated based on current data and decreased human health risks associated with consumption of fish and crabs from this area.

REFERENCES

1. EPA, 1987. The National Dioxin Study. U.S. Environmental Protection Agency, Washington D.C. EPA 440/4-87-003.
2. EPA, 1994. Guidance for Assessing Chemical Contaminant Data For Use in Fish Advisories. Volume 2. Risk Assessment and Fish Consumption Limits. Office of Science and Technology. U.S. Environmental Protection Agency, Wash. D.C. EPA 823-B-94-004
3. IRIS, 1997. Integrated Risk Information System. U.S. Environmental Protection Agency, Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office. Cincinnati, OH.
4. EPA, 1992. National Study of Chemical Residues in Fish. U.S. Environmental Protection Agency. Office of Science and Technology, Wash. D.C. EPA 823-R-92-008a.
5. Agency for Toxic Substances and Disease Registry. Toxicological profile for DDT, DDE, DDD (draft). Atlanta, GA, ATSDR, Feb 19, 1993.
6. Agency for Toxic Substances and Disease Registry. Toxicological profile for Hexachlorobenzene. Atlanta, GA, ATSDR, Dec., 1990.
7. Agency for Toxic Substances and Disease Registry. Toxicological profile for Benzene (draft). Atlanta, GA, ATSDR, Feb. 20, 199.

PREPARERS OF THE REPORT

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CERTIFICATION

This Health Consultation was prepared by the Texas Department of Health under the a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the Health Consultation was initiated.

Technical Project Officer, SPS, RPB, DHAC

The Division of Health Assessment and Consultation, ATSDR, has reviewed this Health Consultation and concurs with its findings.

Director, DHAC, ATSDR