

Summary of Naïve Rat/Rat Chow/Fish Meal Study Analyses Conducted by the 3M Environmental Lab (prepared 03/01/01)

Naïve Rats

(Taken from summary report issued in 1998.) In order to assess "endogenous" levels of PFOS in test animals, the livers of ninety rats from three different suppliers were quantitatively analyzed for PFOS. Three distinct ages of rats were represented in the group of animals received from each supplier: 6-8 weeks old, 10-14 weeks old, and retired breeders (> 14 weeks).

Rat livers from Charles River and Taconic Farms test animals showed measurable endogenous levels of PFOS. Livers collected from oldest group of male rats from Taconic Farms contained more PFOS than any other group in the study.

The livers of test animals from Harlan did not contain PFOS above the limit of detection (15 ng/g).

PFOS levels in the livers of male rats from Charles River and Taconic Farms roughly correlated with the age of the animals. That is, livers collected from the youngest male rats, 6-8 weeks old, contained the least PFOS, while the old, retired breeder male rats contained the highest concentration.

The livers of the female rats from Charles River and Taconic Farms were determined to contain very consistent levels of PFOS, showing no correlation with age.

Limits of Data:

To assess the possibility that the rats could have been exposed to Et-FOSE-OH from rat chow packaging material, screening for other known metabolites of Et-FOSE-OH (e.g. PFOSA, PFOSAA) was performed. The original summary report document stated that "No other known fluorochemical contaminants or metabolites were identified in the liver samples analyzed in this study." However, based on the levels of PFOS observed in the liver samples, the analytical LOQ may not have been sufficient to see expected metabolite levels. (Based on the 2 years Et-FOSE-OH feeding study, PFOSAA levels would be expected to be approximately 9% of PFOS levels; PFOSA concentrations would be expected to be approximately 5% of PFOS levels. Back calculated, the expected concentrations of the metabolites are near the 1998 LOQ. Data from the relatively high-dose 2 year feeding study may or may not provide an acceptable model of this low-level exposure.) Conclusive analysis of the liver samples with respect to these metabolites may help differentiate between potential sources of exposure for the rats.

Spike recovery studies were conducted for PFOS in rat livers and were acceptable. Matrix spike studies conducted for other analytes were, for the most part, acceptable.

Rat Chow

Rat chow from 4 separate vendors was investigated. Two of the sources of rat chow were determined to contain PFOS above the limit of quantitation.

NIH/PMI Lab diet, fed to rats obtained from Charles River was determined to contain approx 18 ng/g PFOS. Small animal diet from Zeigler, fed to rats purchased from Taconic Farms was determined to contain approximately 12 ng/g of PFOS. Teklad rat/rodent diet, fed to rats obtained from Harlan, did not contain PFOS above the LOQ.

Limits of the Data:

Spike recoveries studies were conducted on each type of chow tested and all results were acceptable in all cases (77-98%). The LOQ for PFOS in rat chow is approximately 2-10 ng/g.

Fish Meal

There is great variability in both the source and types of fishmeal available commercially. This variability complicates the analysis of fishmeal and the interpretation of data concerning fishmeal.

Fishmeals used for animal and fish diet are typically generated from what are referred to as "industrial fish". Industrial fish, including menhaden and herring, are usually quite high in oil content and thus not fit for human consumption. Approximately 90% of the world's fishmeal is produced from industrial fish. Fishmeal is processed in factories or directly on the fishing vessel and results in the production of several separate fishmeal products. After the fish are cooked, a liquor (oil, water, and protein) is separated from the solids by "pressing". The solid that remains after pressing is called the "presscake", the liquid component, oil and soluble protein, is "stickwater". Subsequent to pressing, the oil is separated from the remaining components of the stickwater by centrifugation. After further distillation, this fish oil may be directly incorporated into animal diet. The remaining stickwater is evaporated down to a thick syrup of 30-50% solids and may be sold as "condensed fish solubles". The syrup may also be added back to the presscake and dried and sold as "whole meal". Presscake without the syrup is sold as "presscake meal." All of these components may be incorporated into animal feed.

According to the University of Florida Corporate Extension Service, good quality fishmeal averages 60-70% protein; the oil content ranges from 2-15%.

Fishmeal is incorporated into food for a variety of animals and fish including farm-raised salmon, poultry, and cows (particularly dairy cows).

In this study, six types of fishmeal, arising from at least 3 types of fish, were analyzed.

- Menhaden travel in large schools and migrate up the coast each year. They are found in warmer, near shore waters and in the US, are fished primarily off Atlantic Coast. Menhaden constitute 98% of the fishmeal produced in the US.
- Capelin, also a schooling fish, spend much of their lives off shore in the deep waters of the Northern Pacific and the Arctic and move in-shore only to spawn.
- The habitat for different classes of herring is much more far ranging than that of either menhaden or capelin. Different types of herring can be found from the Northern Pacific waters off the coast of Canada and down to the southeastern Atlantic coast. Like menhaden and capelin, herring are small, schooling fish and thus are targeted for large-scale netting.

Type of Fishmeal Analyzed	PFOS (ng/g)
Herring	< LOQ (approx 3 ng/g)
Capelin	< LOQ (approx 3 ng/g)
Protein Concentrate (type of fishmeal not specified)	< LOQ (approx 3 ng/g)
Omega Protein FAQ (type of fishmeal not specified)	15.7
Omega Protein Sealac (presumed to be menhaden)	9.87
Menhaden Fishmeal	6.10

Limits of the data:

Matrix spike studies were conducted on a single type of fishmeal (menhaden). PFOS spiked into the menhaden fishmeal was recovered at approximately 66%. Matrix spike studies were not conducted for the remaining types of fishmeal tested.

The LOQ for PFOS determination in these fishmeal samples was approximately 3.5 ng/g.

Summary of the 3 components of this study:

Vendor of Rats	Rats with endogenous PFOS?	Rat Chow used by Vendor Contains PFOS?	Rat Chow used by Vendor Contains fishmeal?
Charles River	Yes	Yes	Yes
Taconic Farms	Yes	Yes	Yes
Harlan	No (LOQ=30 ng/g)	No (LOQ=2 ng/g)	No

Limits of the study:

Because it is not known what type of fishmeal was incorporated into the various rat chows, it cannot be definitively concluded that fishmeal is the source of PFOS in the rat chow. Although indirect evidence indicates this probability, because PFOS was only detected in 50% of the fishmeal samples analyzed, analysis of the actual fishmeal incorporated into the chow is required to provide a direct link.

Other variables affecting the rats prior to shipment to 3M (such as PFOS levels in water and in other components of the feed) have not been tested. To the best of my memory, this chow has not been tested for the potential of EtFOSE-OH transfer from packaging.

Should further work be conducted on the tissue samples, a lower level screen for metabolites and other known fluorochemicals is recommended. This information would provide additional evidence concerning the origin of PFOS identified in rat livers.

The motivation to pursue any of these additional investigations depends on the corporation's end use of this data. The original study objective: "... to determine what PFOS levels, if any, are present in Sprague Dawley rats of three different ages from three different suppliers" (Medical Dept. protocol for study # T-6319.9) was completed upon issuance of the Environmental Lab summary report in 1998.

