

APPENDIX C

DOSE MODIFICATIONS DUE TO FOOD PREPARATION AND COOKING

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C.1 DOSE MODIFICATIONS OF FISH CONTAMINANT EXPOSURE

Fish preparation and cooking procedures can modify the amount of contaminant ingested by fish consumers. Consequently, exposure and dose are modified. Incorporating a dose modification factor into the exposure equation to account for loss of chemical contaminants from fish tissue during preparation and cooking requires two types of information:

- Methods used by fish consumers to prepare (trimming, skinning) and cook (broiling, baking, , charbroiling, canning, deep frying, pan frying, microwaving, poaching, roasting, salt boiling, smoking) their catch.
- The extent to which a particular contaminant concentration is likely to be decreased by these culinary methods.

To adjust contaminant concentrations appropriately, the dose modification factors must be matched to the type of sample from which the fish contaminant concentration was measured. For example, it would be inappropriate to apply a dose modification factor for removing skin if the contaminant concentrations in the fish were based on the analysis of a skin-off fillet. To select the correct approach for evaluating exposure, information on both the distribution of chemicals in fish tissue and alterations due to food preparation and cooking must be used. The modified contaminant concentration (based on preparation and cooking losses) is used to modify the exposure estimates used in the risk equations. This information is also useful in development of fish advisories and risk communication activities.

C.1.1 Contaminant Distribution in Fish Tissues

Chemical contaminants are not distributed uniformly in fish. Fatty tissues, for example, will concentrate organic chemicals more readily than muscle tissue. Muscle tissue and viscera will preferentially concentrate other contaminants. This information has important implications for fish analysis and for fish consumers. Depending on how fish are prepared and what parts are eaten, consumers may have significantly differing exposures to chemical contaminants. This section is meant as an overview; states should consult primary research studies for more information. In general, contaminant concentrations differ among

- Fatty tissues, muscle tissue, and internal organs
- Different species of fish
- Different age or size classes of fish
- Type of chemical contaminant present in the fish.

C.1.2 Fish Tissue Types

Lipophilic chemicals accumulate mainly in fatty tissues, including the belly flap, lateral line, subcutaneous and dorsal fat, and the dark muscle, gills, eyes, brain, and internal organs. Some heavy metals, such as cadmium, concentrate more in the liver and kidneys. Muscle tissue often contains lower organic contaminant concentrations than fatty tissues (Great Lakes Sport Fish Advisory Task Force, 1993), but contains more mercury, which binds to muscle proteins (Minnesota Department of Health, 1992).

Many people remove the internal organs before cooking fish and trim off fat and skin before eating, thus decreasing exposure to lipophilic and other contaminants. Removing the fat, however, will not decrease exposure to other contaminants, such as mercury, that are concentrated in muscle and other protein-rich tissues (Gutenmann and Lisk, 1991; Minnesota Department of Health, 1992). Concentrations of mercury have been shown to be higher per gram of fillet in skin-off than in skin-on fillets contaminated with mercury (Gutenmann and Lisk, 1991). Certain populations, including some Asian-Americans and Native American groups, eat parts of the fish other than the fillet and may consume the whole fish. Recipes from many cultures employ whole fish for making soups or stews. As a result, more of the fish contaminants are consumed.

States should take preparation methods of local fisher populations into account when assessing exposure levels and when assessing whether use of a dose modification factor is appropriate for their target fish-consuming population.

C.1.3 Fish Species

Fish accumulate contaminants from the water column, from suspended sediment and organic matter in the water, and from their food. Depending on their propensity to bioaccumulate contaminants (largely a function of their feeding habits, ability to metabolize contaminants, and fat content), different fish species living in the same area may contain very different contaminant concentrations. Due to biomagnification, higher trophic level species are more likely to have higher contaminant concentrations. The tissues of the top predators can contain contaminant levels exceeding those in ambient water or sediments by several orders of magnitude.

Where a fish feeds in the water column also determines its relative bioaccumulation potential. Bottom feeders, such as carp or catfish, are exposed to

more sediments than are fish that feed in mid-water or near the surface of the water column. Bottom feeders, therefore, have a tendency to accumulate more of the dense, hydrophobic contaminants, such as chlordane or polychlorinated biphenyls (PCBs), that are adsorbed to the sediment particles. In addition, fish species vary widely in their fat content. Fish low in fat, such as bass, sunfish, crappies, yellow perch, and walleyes, are less likely to accumulate lipophilic contaminants than fattier fish such as bluefish, rainbow trout, lake trout, some salmon, catfish, and carp. Even within the same species, great differences in fat content may occur. Zabik et al. (1996) reported the average fat content of Lake Michigan lean lake trout (*Salvelinus namaycush namaycush*) was 9.1 percent, which was significantly lower than that of the fat Lake Superior siscowets (*Salvelinus namaycush siscowet*) (20.5 percent). Aquatic organisms also differ in their abilities to metabolize and excrete contaminants. For example, one study found fish more readily able to metabolize benzo[a]pyrene than shrimp, amphipod crustaceans, and clams, respectively (U.S. EPA, 1995a). The ability to break down and excrete chemical contaminants may also differ among fish species.

This differential accumulation of contaminants produces very different exposure levels for individuals eating different species of fish. An individual who eats primarily fatty fish species will receive higher exposures of organic chemical contaminants than an individual who eats primarily leaner fish species. Thus, states should consider multiple species exposure in their decision to issue fish consumption advisories.

C.1.4 Fish Size or Age Class

Larger size classes of fish within the same species generally contain higher concentrations of bioaccumulative contaminants, especially the more persistent chemicals such as mercury, DDT, PCBs, and toxaphene (Gutenmann et al. 1992; U.S. EPA, 1995a). Because larger fish are older, they have had more time to accumulate chemicals from their food and they are more likely to catch larger prey, which themselves have had a longer time to bioaccumulate chemicals (Minnesota Department of Health, 1992). Older fish also concentrate more contaminants in their muscle tissues, which are fattier than muscle tissue in younger fish, particularly along the backbone and lateral lines (Kleeman et al., 1986a). States may choose to issue size-specific consumption advisories and/or explain this correlation of increasing contaminant residues in larger fish within a given species in their public education efforts.

C.1.5 Chemical Contaminants

Many of the target chemicals examined in this guidance series are lipophilic and accumulate in the fatty tissues. Some contaminants (and their congeners) bioaccumulate in fish more readily than others or are more resistant to metabolism and excretion once accumulated than others (Bruggeman et al., 1984; Stern et al., 1992). Thus, fish exposed to the same concentrations of a contaminant may accumulate different levels of contaminants in their tissues

based on their ability to bioaccumulate the contaminant directly from solution or via preconcentration on prey species coupled with their ability to metabolize and excrete the contaminant.

States may wish to use this chemical-specific information on distribution of contaminants in fish tissues to assess whether a local population may be exposed unreasonably to a given contaminant, due to particular eating habits such as eating only one species of fish, eating specific parts (whole fish or organs) of the fish, or eating fish species with a high fat content in contrast to eating leaner species.

C.1.5.1 Heavy Metals—

Several studies indicate that mercury, cadmium, and selenium bind to different tissues in fish than do organochlorines. Mercury, for example, binds strongly to proteins, thereby concentrating in muscle tissues of fish (Gutenmann and Lisk, 1991; Minnesota Department of Health, 1992). Mercury also concentrates in the liver and kidneys, though at generally lower rates (Harrison and Klaverkamp, 1990; Marcovecchio et al., 1988). Thus, trimming and gutting can actually result in a greater average concentration of mercury in the remaining fillet tissues compared with the concentration in the whole untrimmed fish proteins, thereby concentrating in muscle tissues of fish (Gutenmann and Lisk, 1991).

Cadmium concentrates largely in the liver, followed by the kidneys and gills, and less so in the muscle tissue (Harrison and Klaverkamp, 1990; Marcovecchio et al., 1988; Norey et al., 1990), indicating that cadmium concentrations could be decreased by trimming and gutting fish before consumption.

Selenium was shown to concentrate in both the liver and muscle tissues at similar rates (Harrison and Klaverkamp, 1990). Consumers would be likely to receive a lower exposure if they consumed a fillet only rather than consuming the whole fish (including fillet tissue and the liver tissue).

C.1.5.2 Organochlorines—

Organochlorine pesticides, PCBs, dioxins/furans tend to concentrate in fatty tissues (Armbruster et al. 1989; Branson et al., 1985; Bruggeman et al. 1984; Gutenmann et al. 1992; Kleeman et al., 1986a, 1986b; Ryan et al., 1983; Skea et al., 1979; Sanders and Hayes 1988; U.S. EPA, 1995a). Many of these compounds are neither readily metabolized nor excreted and thus tend to biomagnify through the food web (Gardner and White, 1990; Lake et al., 1995; Metcalf and Metcalf, 1997; Muir et al., 1986; Niimi and Oliver, 1989; Oliver and Niimi, 1988; U.S. EPA, 1995a). Because different fish species store fat differently, contain different amounts of body fat, and metabolize these compounds at slightly different rates, each species will also concentrate organochlorine-based contaminants somewhat differently. In general, however, trimming away fatty

tissues, including the skin, are the most effective ways to reduce exposure to these chemicals.

C.1.5.3 Other Contaminants—

The other chemicals examined in this exposure assessment (organophosphate pesticides and oxyfluorfen) have also been found to bioaccumulate in fish, but to a much lower extent than the organochlorine pesticides. Little information is available, however, on the distribution of these chemicals in specific fish tissues. After feeding chlorpyrifos to channel catfish in a laboratory study, the highest concentrations were found in the liver tissue, while less than 5 percent of the dose was found in muscle tissue (Barron et al., 1991). No information was located on the tissue distribution of any of the other organophosphates in feral fish populations. Organophosphates as a group are lipophilic and would be expected to distribute to body fat like the organochlorine compounds. However, the organophosphates are much less persistent in both the environment (U.S. EPA, 1995a) and in aquatic organisms because these compounds are vulnerable to hydrolysis in water and to metabolic breakdown by esterases.

C.2 ESTIMATING DOSE MODIFICATION BASED ON PREPARATION METHODS

This section presents data on the effects of various preparation methods on contaminant concentrations in fish tissue. In the absence of specific data on fish preparation methods, the U.S. Environmental Protection Agency (EPA) recommends using fillets as the standard sample type for analyzing chemical contaminants. Readers are referred to Volume 1, 3rd edition, of this series for a more complete discussion of sample analysis (U.S. EPA, 1999). The sample type should consist of the portion of the individual organism commonly consumed by the general fish-consuming population or a specific target population of concern (e.g., pregnant or nursing women, young children, recreational or subsistence fishers). EPA recommends analyzing skin-on fillets (including the belly flap) for most scaled finfish. Conversely, skin-off fillets may be more appropriate for target species without scales (e.g., catfish). State or local agencies, however, are advised to select the sample type most appropriate for each target species based on consumption patterns of local populations and should sample the whole body of the fish if a local target population typically consumes whole fish. Following these guidelines, states may have concentration data from fillet samples with skin-on, fillet samples with skin-off, or from whole fish.

When states have data on the preparation methods of the target fish-consuming populations, appropriate dose modification factors from these studies can be used to adjust assumed fish chemical contaminant concentrations. Without food preparation data, however, states should not assume that specific preparation methods are employed, since fish preparation and cooking techniques frequently vary among individuals and often depend on the type of fish consumed. As noted earlier, many groups known to consume large quantities of fish, including Native American and Asian American fishers, often consume most of the whole fish and

may do very little trimming. Consequently, assuming a dose reduction in chemical contaminants based on fillet samples may lead to an underestimate of the exposure and risk for these groups that consume whole fish.

EPA recommends the use of dose modification factors for setting health-based intake limits only when data on local methods of preparation and their impact on contaminant concentrations are available.

EPA recommends that all fish advisories emphasize the importance of skinning and trimming fish (including gutting) and certain ways of cooking as effective means to minimize the risks from chemical contaminant residues in fish tissue. To achieve the best results, all three techniques should be used together. States are encouraged to include illustrations in their fish advisories showing the location of fatty tissue in fish and describing the parts of the fish tissue to be trimmed. This type of information could be provided to fish consumers as part of a fish advisory program through risk communication efforts. Further information on risk communication is included in Volume 4 in this series of guidance documents (U.S. EPA, 1995b).

The degree of preparation-related reduction in contaminant concentration depends on

- Fish species and size (age class)
- Chemical contaminant residues present
- Specific food preparation and cooking techniques used.

Consumer concern about the presence of toxic chemicals in fish has focused research on quantitating the effects of processing and cooking on the possible reduction of chemical contaminant levels in fish. Several generalizations about specific food preparation and cooking techniques can be made based on several detailed studies conducted using primarily Great Lakes fish.

- Trimming fish is an important consideration in reducing the levels of PCBs and other organochlorine pesticides ingested by consumers (Hora 1981; Sanders and Haynes, 1988; Zabik et al., 1995b; Zabik and Zabik, 1996). For example, in a recent study, raw skin-off fillets had an average of 50 percent of the residues found in raw skin-on fillets. The skin-off fillets had both the belly flap and the lateral line and its associated fat trimmed off, while the skin-on fillet had only the belly flap removed. Zabik et al. (1995b) also established that this contaminant reduction was carried over to cooked fillets.
- Cooking methods that allow the separation of the cooked muscle from the skin (pan frying, poaching, broiling, baking) reduce the amount of chemical contaminants the consumer would ingest over such cooking methods as deep frying where both the skin and cooked muscle are consumed together (Zabik et al., 1995a).

- As a cooking process, smoking resulted in significantly greater reductions (40 to >50 percent) of organochlorine pesticides (DDT, DDE, DDD, chlordane complex, HCB, dieldrin, heptachlor epoxide, toxaphene), total PCBs, and dioxin residues (TCDD) than other cooking methods (baking, charbroiling, salt boiling, deep fat frying, canning) tested, but polynuclear aromatic compounds (PAHs) showed significant formation during the smoking process especially in fish species with higher body fat levels (siscowet) (Zabik et al., 1996).
- For dioxins, several organochlorine pesticides, and PCBs, increasing the internal temperature of the cooked fish from 60 to 80 °C (Stachiw et al., 1988), increasing the surface area exposed to the cooking process by scoring the fillets (Stachiw et al., 1988; Zabik et al., 1994), or increasing the cooking time or cooking temperature enhances the loss of contaminant residues in the fish (Zabik and Zabik, 1996).
- For PCBs, residue reductions during cooking (baking and charbroiling) of the homologues with the lowest and the highest numbers of chlorines (trichloro-, tetrachloro- and octachloro-PCBs) tended to be less than residue reductions for the pentachloro-, hexachloro- and heptachloro-PCBs, which typically make up the major portion of the PCBs found in fish samples (Zabik and Zabik, 1996).
- In general for heavy metals, tissue residues are not significantly reduced by processing or cooking methods (Gutenmann and Lisk, 1991; Zabik and Zabik, 1996).

The results of a number of fish preparation and cooking studies are presented in Tables C-1 and C-2 for a variety of fish species. The data are relevant primarily to concentrations in the standard fillet. Dose modification will depend on how the dose is determined initially (i.e., what portion of the fish was analyzed to determine contamination concentrations). Note that contaminants distributed throughout the fish muscle tissue, such as mercury, will not be substantially reduced through most fish preparation or cooking methods.

Table C-1 summarizes various study results where specific activities reduce contaminants in standard fillets of fish species. Study citations are provided for readers who wish to obtain more information on study methods and results. Similar information obtained from studies of standard fillet, whole fish, or other fillet types is presented in Table C-2. Both show that a high level of variability should be expected in the effectiveness of skinning, trimming, and cooking fish. The average reductions are reported for each study. Although significant variability in percent reductions was found within each study, the mean reduction data suggest that significant reductions can occur with food preparation and cooking (Voiland et al., 1991). The cooked weight of fish tissue is always less than the uncooked weight. On average, cooking reduces the fish weight by about one-third (Great Lakes Sport Fish Advisory Task Force, 1993); therefore, the standard

meal of 1/2 pound of raw fillet weighs about 1/3 pound after cooking. Most of the weight reduction is due to water loss, but fat liquification and volatilization also contribute to weight reduction (Great Lakes Sport Fish Advisory Task Force, 1993). The actual weight loss depends on the cooking technique used.

The results of studies shown in Tables C-1 through C-3 do not address chemical degradation due to heat applied in cooking. Zabik et al. (1994) found that smoking lake trout reduced pesticides and total PCBs significantly more than other cooking methods, but this cooking method resulted in the formation of PAHs. Until there is more information about the toxicity of the byproducts generated during the degradation of PCBs, dioxins/furans, organochlorine pesticides, or the other chemicals of concern, EPA recommends that no dose modification be assumed due to degradation alone.

Zabik et al. (1994) found similarities in the percentage of pesticide and total PCB reductions (ranging from 27.9 to 36.5 percent) attributed to cooking for Great Lakes carp, salmon, lake trout, walleye, and white bass analyzed (Table C-3). However, they assessed only lipophilic chlorinated hydrocarbons. Similarities in their chemical behavior may be responsible for the similarities observed in the study results listed in Table C-3. The information provided in this table is not species-specific, which may limit the situations to which it is applicable.

Table C-1. Summary of Contaminant Reductions Due to Skinning, Trimming, and Cooking (Based on Standard Fillet)

Species	Contaminant	Activity ^a	Reduction (%) ^b	Reference
Brown Trout	DDE	Trimming	52	Skea et al. (1979)
	DDE	Smoking	27	Skea et al. (1979)
	DDE	Broiling	20	Skea et al. (1979)
	Mirex	Trimming	44	Voiland et al. (1991)
	Mirex	Trimming	45	Skea et al. (1979)
	Mirex	Smoking	39	Skea et al. (1979)
	Mirex	Broiling	26	Skea et al. (1979)
	Mirex	Trimming & cooking	74	Skea et al. (1979)
	PCB	Trimming	46	Voiland et al. (1991)
	PCB	Trimming	43	Skea et al. (1979)
	PCB	Smoking	27	Skea et al. (1979)
	PCB	Broiling	0	Skea et al. (1979)
PCB	Trimming & cooking	78	Skea et al. (1979)	
Carp	α-Chlordane	Skin-off & deep frying	44	Zabik et al. (1994)
	α-Chlordane	Skin-off & pan frying	17	Zabik et al. (1994)
	α-Chlordane	Skin-on & deep frying	38	Zabik et al. (1994)
	α-Chlordane	Skin-on & pan frying	51	Zabik et al. (1994)
	Dieldrin	Skin-off & deep frying	76	Zabik et al. (1994)
	Dieldrin	Skin-off & pan frying	58	Zabik et al. (1994)
	Dieldrin	Skin-on & deep frying	56	Zabik et al. (1994)
	Dieldrin	Skin-on & pan frying	59	Zabik et al. (1994)
	Heptachlor epoxide	Skin-on & pan frying	82	Zabik et al. (1994)
	PCB	Skin-off & deep frying	37	Zabik et al. (1994)
	PCB	Skin-off & pan frying	25	Zabik et al. (1994)
	PCB	Skin-on & deep frying	38	Zabik et al. (1994)
Carp (Great Lakes)	TCDD	skin-on & cooked	approx. 37	Zabik & Zabik 1995
	TCDD	skin off & cooked	approx. 54	Zabik & Zabik 1995
(Lake Erie)	p,p'-DDE	skin-on & deep fried	28	Zabik et al. 1995b
Carp (Lake Erie)	p,p'-DDE	skin off & deep fried	45	Zabik et al. 1995b
	p,p'-DDD	skin-on & deep fried	30	Zabik et al. 1995b
	p,p'-DDD	skin off & deep fried	35	Zabik et al. 1995b
	α- chlordane	skin-on & deep fried	37	Zabik et al. 1995b
	α- chlordane	skin off & deep fried	56	Zabik et al. 1995b
	γ- chlordane	skin-on & deep fried	32	Zabik et al. 1995b
	γ- chlordane	skin off & deep fried	41	Zabik et al. 1995b
	cis-nonachlor	skin-on & deep fried	34	Zabik et al. 1995b
	cis-nonachlor	skin off & deep fried	53	Zabik et al. 1995b
	trans-nonachlor	skin-on & deep fried	54 *	Zabik et al. 1995b
	trans-nonachlor	skin off & deep fried	27	Zabik et al. 1995b
	HCB	skin-on & deep fried	14	Zabik et al. 1995b
	HCB	skin off & deep fried	54	Zabik et al. 1995b
	dieldrin	skin-on & deep fried	52	Zabik et al. 1995b
	dieldrin	skin off & deep fried	53	Zabik et al. 1995b
Total PCBs	skin-on & deep fried	16	Zabik et al. 1995b	

See footnotes at end of table.

(continued)

Table C-1. (Continued)

Species	Contaminant	Activity ^a	Reduction (%) ^b	Reference	
Carp (con.) (Lake Erie)	Total PCBs	skin off & deep fried	32	Zabik et al. 1995b	
	p,p'-DDE	skin-on & pan fried	36	Zabik et al. 1995b	
	p,p'-DDE	skin off & pan fried	17	Zabik et al. 1995b	
	p,p'-DDD	skin-on & pan fried	54	Zabik et al. 1995b	
	p,p'-DDD	skin off & pan fried	40	Zabik et al. 1995b	
	α- chlordane	skin-on & pan fried	43	Zabik et al. 1995b	
	α- chlordane	skin off & pan fried	26	Zabik et al. 1995b	
	γ- chlordane	skin-on & pan fried	20	Zabik et al. 1995b	
	oxychlordane	skin-on & pan fried	38	Zabik et al. 1995b	
	cis-nonachlor	skin-on & pan fried	42	Zabik et al. 1995b	
	trans-nonachlor	skin-on & pan fried	7	Zabik et al. 1995b	
	trans-nonachlor	skin off & pan fried	3 *	Zabik et al. 1995b	
	TCDF	skin-on & pan fried	138 *	Zabik et al. 1995b	
	TCDF	skin-on & pan fried	27	Zabik et al. 1995b	
	TCDF	skin off & pan fried	19	Zabik et al. 1995b	
	TCDF	skin-on & pan fried	8	Zabik et al. 1995b	
	Total PCBs	skin-on & pan fried	22	Zabik et al. 1995b	
	Total PCBs	skin off & pan fried	19	Zabik et al. 1995b	
	Carp (Lake Huron)	p,p'-DDE	skin-on & deep fried	46	Zabik et al. 1995b
		p,p'-DDE	skin off & deep fried	39	Zabik et al. 1995b
p,p'-DDD		skin-on & deep fried	31	Zabik et al. 1995b	
p,p'-DDD		skin off & deep fried	51	Zabik et al. 1995b	
α- chlordane		skin-on & deep fried	32	Zabik et al. 1995b	
α- chlordane		skin off & deep fried	33	Zabik et al. 1995b	
γ- chlordane		skin-on & deep fried	29	Zabik et al. 1995b	
cis-nonachlor		skin-on & deep fried	54	Zabik et al. 1995b	
trans-nonachlor		skin-on & deep fried	13 *	Zabik et al. 1995b	
trans-nonachlor		skin off & deep fried	27	Zabik et al. 1995b	
TCDF		skin-on & deep fried	33	Zabik et al. 1995b	
TCDF		skin off & deep fried	27	Zabik et al. 1995b	
TCDF		skin-on & deep fried	44	Zabik et al. 1995b	
Total PCBs		skin-on & deep fried	67	Zabik et al. 1995b	
Total PCBs		skin off & deep fried	32	Zabik et al. 1995b	
p,p'-DDE		skin-on & pan fried	48	Zabik et al. 1995b	
p,p'-DDE		skin off & pan fried	50	Zabik et al. 1995b	
p,p'-DDD		skin-on & pan fried	38	Zabik et al. 1995b	
p,p'-DDD		skin off & pan fried	17	Zabik et al. 1995b	
α- chlordane		skin-on & pan fried	55	Zabik et al. 1995b	
α- chlordane		skin off & pan fried	35	Zabik et al. 1995b	
γ- chlordane		skin-on & pan fried	50	Zabik et al. 1995b	
cis-nonachlor		skin-on & pan fried	54	Zabik et al. 1995b	
trans-nonachlor		skin-on & pan fried	35	Zabik et al. 1995b	
trans-nonachlor		skin off & pan fried	39	Zabik et al. 1995b	
TCDF		skin-on & pan fried	19	Zabik et al. 1995b	
TCDF		skin off & pan fried	10 *	Zabik et al. 1995b	
TCDF		skin-on & pan fried	93	Zabik et al. 1995b	
Total PCBs		skin-on & pan fried	42	Zabik et al. 1995b	

See footnotes at end of table.

(continued)

Table C-1. (Continued)

Species	Contaminant	Activity ^a	Reduction (%) ^b	Reference
Carp (con.) (Lake Huron)	Total PCBs	skin off & pan fried	37	Zabik et al. 1995b
	PCB	Skin-on & pan frying	31	Zabik et al. (1994)
Chinook	α -Chlordane	Skin-off & baking	44	Zabik et al. (1994)
Salmon	α -Chlordane	Skin-off & charbroiling	41	Zabik et al. (1994)
	α -Chlordane	Skin-off & charbroiling after scoring	45	Zabik et al. (1994)
	α -Chlordane	Skin-off & canning	37	Zabik et al. (1994)
	α -Chlordane	Skin-on & baking	27	Zabik et al. (1994)
	α -Chlordane	Skin-on & charbroiling	42	Zabik et al. (1994)
	α -Chlordane	Skin-on & charbroiling after scoring	51	Zabik et al. (1994)
	Dieldrin	Skin-off & baking	30	Zabik et al. (1994)
	Dieldrin	Skin-off & charbroiling	31	Zabik et al. (1994)
	Dieldrin	Skin-off & charbroiling after scoring	40	Zabik et al. (1994)
	Dieldrin	Skin-off & canning	40	Zabik et al. (1994)
	Dieldrin	Skin-on & baking	29	Zabik et al. (1994)
	Dieldrin	Skin-on & charbroiling	40	Zabik et al. (1994)
	Dieldrin	Skin-on & charbroiling after scoring	50	Zabik et al. (1994)
	Heptachlor epoxide	Skin-off & baking	52	Zabik et al. (1994)
	Heptachlor epoxide	Skin-off & charbroiling	40	Zabik et al. (1994)
	Heptachlor epoxide	Skin-off & charbroiling after scoring	42	Zabik et al. (1994)
	Heptachlor epoxide	Skin-off & canning	37	Zabik et al. (1994)
	Heptachlor epoxide	Skin-on & baking	23	Zabik et al. (1994)
	Heptachlor epoxide	Skin-on & charbroiling	45	Zabik et al. (1994)
	Heptachlor epoxide	Skin-on & charbroiling after scoring	48	Zabik et al. (1994)
	PCB	Skin-off & baking	38	Zabik et al. (1994)
	PCB	Skin-off & charbroiling	44	Zabik et al. (1994)
	PCB	Skin-off & charbroiling after scoring	46	Zabik et al. (1994)
	PCB	Skin-off & canning	36	Zabik et al. (1994)
	PCB	Skin-on & baking	33	Zabik et al. (1994)
	PCB	Skin-on & charbroiling	40	Zabik et al. (1994)
	PCB	Skin-on & charbroiling after scoring	49	Zabik et al. (1994)
	Toxaphene	Skin-off & baking	34	Zabik et al. (1994)
Toxaphene	Skin-off & charbroiling	30	Zabik et al. (1994)	
Toxaphene	Skin-off & charbroiling after scoring	34	Zabik et al. (1994)	
Toxaphene	Skin-off & canning	74	Zabik et al. (1994)	
Toxaphene	Skin-on & baking	22	Zabik et al. (1994)	
Toxaphene	Skin-on & charbroiling	37	Zabik et al. (1994)	
Toxaphene	Skin-on & charbroiling after scoring	47	Zabik et al. (1994)	
Chinook Salmon (Great Lakes)	TCDD	skin-on & cooked	approx. 43	Zabik & Zabik 1995
	TCDD	skin off & cooked	approx. 57	Zabik & Zabik 1995
Chinook Salmon (Lake Huron)	p,p'-DDT	skin-on & baked	23	Zabik et al. 1995b
	p,p'-DDT	skin-off & baked	26	Zabik et al. 1995b
	p,p'-DDE	skin-on & baked	35	Zabik et al. 1995b
	p,p'-DDE	skin-off & baked	47	Zabik et al. 1995b
	p,p'-DDD	skin-on & baked	27	Zabik et al. 1995b
	p,p'-DDD	skin-off & baked	4	Zabik et al. 1995b
	α - chlordane	skin-on & baked	33	Zabik et al. 1995b
	α - chlordane	skin-off & baked	51	Zabik et al. 1995b

See footnotes at end of table.

(continued)

Table C-1. (Continued)

Species	Contaminant	Activity ^a	Reduction (%) ^b	Reference
Chinook Salmon (Lake Huron) (con.)	γ - chlordane	skin-on & baked	33	Zabik et al. 1995b
	γ - chlordane	skin-off & baked	43	Zabik et al. 1995b
	oxychlordane	skin-on & baked	42	Zabik et al. 1995b
	oxychlordane	skin-off & baked	50	Zabik et al. 1995b
	cis-nonachlor	skin-on & baked	31	Zabik et al. 1995b
	cis-nonachlor	skin-off & baked	46	Zabik et al. 1995b
	trans-nonachlor	skin-on & baked	43	Zabik et al. 1995b
	trans-nonachlor	skin-off & baked	41	Zabik et al. 1995b
	TCB	skin-on & baked	48	Zabik et al. 1995b
	TCB	skin-off & baked	60	Zabik et al. 1995b
	dieldrin	skin-on & baked	38	Zabik et al. 1995b
	dieldrin	skin-off & baked	35	Zabik et al. 1995b
	heptachlor epoxide	skin-on & baked	36	Zabik et al. 1995b
	heptachlor epoxide	skin-off & baked	44	Zabik et al. 1995b
	toxaphene	skin-on & baked	38	Zabik et al. 1995b
	toxaphene	skin-off & baked	49	Zabik et al. 1995b
	Total PCBs	skin-on & baked	49	Zabik et al. 1995b
	Total PCBs	skin-off & baked	48	Zabik et al. 1995b
	p,p'-DDT	skin-on & charbroiled	35	Zabik et al. 1995b
	p,p'-DDT	skin-off & charbroiled	50	Zabik et al. 1995b
	p,p'-DDE	skin-on & charbroiled	41	Zabik et al. 1995b
	p,p'-DDE	skin-off & charbroiled	61	Zabik et al. 1995b
	p,p'-DDD	skin-on & charbroiled	39	Zabik et al. 1995b
	p,p'-DDD	skin-off & charbroiled	62	Zabik et al. 1995b
	α - chlordane	skin-on & charbroiled	44	Zabik et al. 1995b
	α - chlordane	skin-off & charbroiled	63	Zabik et al. 1995b
	γ - chlordane	skin-on & charbroiled	38	Zabik et al. 1995b
	γ - chlordane	skin-off & charbroiled	48	Zabik et al. 1995b
	oxychlordane	skin-on & charbroiled	62	Zabik et al. 1995b
	oxychlordane	skin-off & charbroiled	59	Zabik et al. 1995b
	cis-nonachlor	skin-on & charbroiled	45	Zabik et al. 1995b
	cis-nonachlor	skin-off & charbroiled	61	Zabik et al. 1995b
	trans-nonachlor	skin-on & charbroiled	45	Zabik et al. 1995b
	trans-nonachlor	skin-off & charbroiled	61	Zabik et al. 1995b
	TCB	skin-on & charbroiled	47	Zabik et al. 1995b
	TCB	skin-off & charbroiled	49	Zabik et al. 1995b
	dieldrin	skin-on & charbroiled	47	Zabik et al. 1995b
	dieldrin	skin-off & charbroiled	51	Zabik et al. 1995b
	heptachlor epoxide	skin-on & charbroiled	45	Zabik et al. 1995b
	heptachlor epoxide	skin-off & charbroiled	55	Zabik et al. 1995b
	toxaphene	skin-on & charbroiled	41	Zabik et al. 1995b
	toxaphene	skin-off & charbroiled	47	Zabik et al. 1995b
	Total PCBs	skin-on & charbroiled	40	Zabik et al. 1995b
	Total PCBs	skin-off & charbroiled	62	Zabik et al. 1995b
	p,p'-DDT	skin-on, scored & charbroiled	58	Zabik et al. 1995b
	p,p'-DDT	skin-off, scored & charbroiled	59	Zabik et al. 1995b
	p,p'-DDE	skin-on, scored & charbroiled	59	Zabik et al. 1995b

See footnotes at end of table.

(continued)

Table C-1. (Continued)

Species	Contaminant	Activity ^a	Reduction (%) ^b	Reference
Chinook	p,p'-DDE	skin-off , scored & charbroiled	51	Zabik et al. 1995b
Salmon (con.)	p,p'-DDD	skin-on, scored & charbroiled	54	Zabik et al. 1995b
(Lake Huron)	p,p'-DDD	skin-off , scored & charbroiled	57	Zabik et al. 1995b
	α- chlordane	skin-on, scored & charbroiled	63	Zabik et al. 1995b
	α- chlordane	skin-off , scored & charbroiled	54	Zabik et al. 1995b
	oxychlordane	skin-on, scored & charbroiled	49	Zabik et al. 1995b
	oxychlordane	skin-off, scored & charbroiled	50	Zabik et al. 1995b
	cis-nonachlor	skin-on, scored & charbroiled	49	Zabik et al. 1995b
	cis-nonachlor	skin-off, scored & charbroiled	50	Zabik et al. 1995b
	trans-nonachlor	skin-on, scored & charbroiled	63	Zabik et al. 1995b
	trans-nonachlor	skin-off, scored & charbroiled	54	Zabik et al. 1995b
	HCB	skin-on, scored & charbroiled	50	Zabik et al. 1995b
	HCB	skin-off , scored & charbroiled	46	Zabik et al. 1995b
	dieldrin	skin-on, scored & charbroiled	62	Zabik et al. 1995b
	dieldrin	skin-off , scored & charbroiled	43	Zabik et al. 1995b
	heptachlor epoxide	skin-on, scored & charbroiled	57	Zabik et al. 1995b
	heptachlor epoxide	skin-off, scored & charbroiled	56	Zabik et al. 1995b
	toxaphene	skin-on, scored & charbroiled	56	Zabik et al. 1995b
	toxaphene	skin-off, scored & charbroiled	48	Zabik et al. 1995b
	Total PCBs	skin-on, scored & charbroiled	61	Zabik et al. 1995b
	Total PCBs	skin-off, scored & charbroiled	52	Zabik et al. 1995b
	p,p'-DDT	canned with skin-off	80	Zabik et al. 1995b
	p,p'-DDE	canned with skin-off	38	Zabik et al. 1995b
	p,p'-DDD	canned with skin-off	8 *	Zabik et al. 1995b
	α- chlordane	canned with skin-off	51	Zabik et al. 1995b
	γ - chlordane	canned with skin-off	56	Zabik et al. 1995b
	oxychlordane	canned with skin-off	47	Zabik et al. 1995b
	cis-nonachlor	canned with skin-off	46	Zabik et al. 1995b
	trans-nonachlor	canned with skin-off	53	Zabik et al. 1995b
	HCB	canned with skin-off	27	Zabik et al. 1995b
	dieldrin	canned with skin-off	88	Zabik et al. 1995b
	toxaphene	canned with skin-off	77	Zabik et al. 1995b
	Total PCBs	canned with skin-off	33	Zabik et al. 1995b
Chinook Salmon	p,p'-DDT	skin-on & baked	23	Zabik et al. 1995b
(Lake Michigan)	p,p'-DDT	skin-off & baked	26	Zabik et al. 1995b
	p,p'-DDE	skin-on & baked	16	Zabik et al. 1995b
	p,p'-DDE	skin-off & baked	26	Zabik et al. 1995b
	p,p'-DDD	skin-on & baked	10	Zabik et al. 1995b
	p,p'-DDD	skin-off & baked	30	Zabik et al. 1995b
	α- chlordane	skin-on & baked	29	Zabik et al. 1995b
	α- chlordane	skin-off & baked	31	Zabik et al. 1995b
	γ- chlordane	skin-on & baked	28	Zabik et al. 1995b
	γ- chlordane	skin-off & baked	22	Zabik et al. 1995b
	oxychlordane	skin-on & baked	2810	Zabik et al. 1995b
	oxychlordane	skin-off & baked	2236	Zabik et al. 1995b
	cis-nonachlor	skin-on & baked	32	Zabik et al. 1995b
	cis-nonachlor	skin-off & baked	33	Zabik et al. 1995b

See footnotes at end of table.

(continued)

Table C-1. (Continued)

Species	Contaminant	Activity ^a	Reduction (%) ^b	Reference
Chinook Salmon (Lake Michigan) (con.)	trans-nonachlor	skin-on & baked	28	Zabik et al. 1995b
	trans-nonachlor	skin-off & baked	28	Zabik et al. 1995b
	HCB	skin-on & baked	34	Zabik et al. 1995b
	HCB	skin-off & baked	27	Zabik et al. 1995b
	dieldrin	skin-on & baked	21	Zabik et al. 1995b
	dieldrin	skin-off & baked	25	Zabik et al. 1995b
	heptachlor epoxide	skin-on & baked	14	Zabik et al. 1995b
	heptachlor epoxide	skin-off & baked	32	Zabik et al. 1995b
	toxaphene	skin-on & baked	7	Zabik et al. 1995b
	toxaphene	skin-off & baked	22	Zabik et al. 1995b
Chinook Salmon (Lake Huron)	Total PCBs	skin-on & baked	25	Zabik et al. 1995b
Chinook Salmon (Lake Michigan)	Total PCBs	skin-off & baked	29	Zabik et al. 1995b
	p,p'-DDT	skin-on & charbroiled	48	Zabik et al. 1995b
	p,p'-DDT	skin-off & charbroiled	23	Zabik et al. 1995b
	p,p'-DDE	skin-on & charbroiled	41	Zabik et al. 1995b
	p,p'-DDE	skin-off & charbroiled	30	Zabik et al. 1995b
	p,p'-DDD	skin-on & charbroiled	48	Zabik et al. 1995b
	p,p'-DDD	skin-off & charbroiled	20	Zabik et al. 1995b
	α- chlordane	skin-on & charbroiled	43	Zabik et al. 1995b
	α- chlordane	skin-off & charbroiled	27	Zabik et al. 1995b
	γ- chlordane	skin-on & charbroiled	43	Zabik et al. 1995b
	γ- chlordane	skin-off & charbroiled	29	Zabik et al. 1995b
	oxychlordane	skin-on & charbroiled	46	Zabik et al. 1995b
	oxychlordane	skin-off & charbroiled	21	Zabik et al. 1995b
	cis-nonachlor	skin-on & charbroiled	49	Zabik et al. 1995b
	cis-nonachlor	skin-off & charbroiled	31	Zabik et al. 1995b
	trans-nonachlor	skin-on & charbroiled	43	Zabik et al. 1995b
	trans-nonachlor	skin-off & charbroiled	21	Zabik et al. 1995b
	HCB	skin-on & charbroiled	53	Zabik et al. 1995b
	HCB	skin-off & charbroiled	40	Zabik et al. 1995b
	dieldrin	skin-on & charbroiled	39	Zabik et al. 1995b
	dieldrin	skin-off & charbroiled	12	Zabik et al. 1995b
	heptachlor epoxide	skin-on & charbroiled	48	Zabik et al. 1995b
	heptachlor epoxide	skin-off & charbroiled	29	Zabik et al. 1995b
toxaphene	skin-on & charbroiled	33	Zabik et al. 1995b	
toxaphene	skin-off & charbroiled	16	Zabik et al. 1995b	
Chinook Salmon (Lake Huron)	Total PCBs	skin-on & charbroiled	44	Zabik et al. 1995b
Chinook Salmon (Lake Michigan)	Total PCBs	skin-off & charbroiled	33	Zabik et al. 1995b
	p,p'-DDT	skin-on, scored, & charbroiled	54	Zabik et al. 1995b
	p,p'-DDT	skin-off, scored, & charbroiled	45	Zabik et al. 1995b
	p,p'-DDE	skin-on, scored, & charbroiled	35	Zabik et al. 1995b
	p,p'-DDE	skin-off, scored, & charbroiled	34	Zabik et al. 1995b
	p,p'-DDD	skin-on, scored, & charbroiled	34	Zabik et al. 1995b
	p,p'-DDD	skin-off, scored, & charbroiled	42	Zabik et al. 1995b
	α- chlordane	skin-on, scored, & charbroiled	46	Zabik et al. 1995b

See footnotes at end of table.

(continued)

Table C-1. (Continued)

Species	Contaminant	Activity ^a	Reduction (%) ^b	Reference
Chinook Salmon (Lake Michigan) (con.)	α - chlordane	skin-off , scored, & charbroiled	39	Zabik et al. 1995b
	γ - chlordane	skin-on, scored, & charbroiled	47	Zabik et al. 1995b
	γ - chlordane	skin-off , scored, & charbroiled	32	Zabik et al. 1995b
	oxychlordane	skin-on, scored, & charbroiled	34	Zabik et al. 1995b
	oxychlordane	skin-off , scored, & charbroiled	33	Zabik et al. 1995b
	cis-nonachlor	skin-on, scored, & charbroiled	51	Zabik et al. 1995b
	cis-nonachlor	skin-off , scored, & charbroiled	41	Zabik et al. 1995b
	trans-nonachlor	skin-on, scored, & charbroiled	37	Zabik et al. 1995b
	trans-nonachlor	skin-off , scored, & charbroiled	44	Zabik et al. 1995b
	HCB	skin-on, scored, & charbroiled	31	Zabik et al. 1995b
	HCB	skin-off , scored, & charbroiled	43	Zabik et al. 1995b
	dieldrin	skin-on, scored, & charbroiled	42	Zabik et al. 1995b
	dieldrin	skin-off , scored, & charbroiled	41	Zabik et al. 1995b
	heptachlor epoxide	skin-on, scored, & charbroiled	42	Zabik et al. 1995b
	heptachlor epoxide	skin-off , scored, & charbroiled	31	Zabik et al. 1995b
	toxaphene	skin-on, scored, & charbroiled	37	Zabik et al. 1995b
	toxaphene	skin-off , scored, & charbroiled	22	Zabik et al. 1995b
Chinook Salmon (Lake Huron)	Total PCBs	skin-on, scored, & charbroiled	37	Zabik et al. 1995b
Chinook Salmon (Lake Michigan)	Total PCBs	skin-off , scored, & charbroiled	44	Zabik et al. 1995b
	p,p'-DDT	canned with skin-off	141 *	Zabik et al. 1995b
	p,p'-DDE	canned with skin-off	37	Zabik et al. 1995b
	p,p'-DDD	canned with skin-off	34 *	Zabik et al. 1995b
	α - chlordane	canned with skin-off	35	Zabik et al. 1995b
	γ - chlordane	canned with skin-off	35	Zabik et al. 1995b
	oxychlordane	canned with skin-off	30	Zabik et al. 1995b
	cis-nonachlor	canned with skin-off	28	Zabik et al. 1995b
	trans-nonachlor	canned with skin-off	43	Zabik et al. 1995b
	HCB	canned with skin-off	33	Zabik et al. 1995b
	dieldrin	canned with skin-off	43	Zabik et al. 1995b
	heptachlor epoxide	canned with skin-off	28	Zabik et al. 1995b
	toxaphene	canned with skin-off	72	Zabik et al. 1995b
	Total PCBs	canned with skin-off	39	Zabik et al. 1995b
Lake Trout	α -Chlordane	Skin-off & baking	26	Zabik et al. (1994)
	α -Chlordane	Skin-off & charbroiling	41	Zabik et al. (1994)
	α -Chlordane	Skin-off & salt boiling	6	Zabik et al. (1994)
	α -Chlordane	Skin-on & smoking	53	Zabik et al. (1994)
	DDT	Skin-off & baking	14	Zabik et al. (1994)
	DDT	Skin-off & charbroiling	21	Zabik et al. (1994)
	DDT	Skin-off & salt boiling	1	Zabik et al. (1994)
	DDT	Skin-on & smoking	60	Zabik et al. (1994)
	Dieldrin	Skin-off & baking	8	Zabik et al. (1994)
	Dieldrin	Skin-off & charbroiling	15	Zabik et al. (1994)
	Dieldrin	Skin-off & salt boiling	16	Zabik et al. (1994)
	Dieldrin	Skin-on & smoking	43	Zabik et al. (1994)
	Heptachlor epoxide	Skin-off & baking	39	Zabik et al. (1994)
Heptachlor epoxide	Skin-off & charbroiling	39	Zabik et al. (1994)	

See footnotes at end of table.

(continued)

Table C-1. (Continued)

Species	Contaminant	Activity ^a	Reduction (%) ^b	Reference
Lake Trout (con.)	Heptachlor epoxide	Skin-off & salt boiling	3	Zabik et al. (1994)
	Heptachlor epoxide	Skin-on & smoking	59	Zabik et al. (1994)
	PCB	Skin-off & baking	13	Zabik et al. (1994)
	PCB	Skin-off & charbroiling	29	Zabik et al. (1994)
	PCB	Skin-off & salt boiling	10	Zabik et al. (1994)
	PCB	Skin-on & smoking	46	Zabik et al. (1994)
	Toxaphene	Skin-off & baking	31	Zabik et al. (1994)
	Toxaphene	Skin-off & charbroiling	40	Zabik et al. (1994)
	Toxaphene	Skin-off & salt boiling	5	Zabik et al. (1994)
	Toxaphene	Skin-on & smoking	51	Zabik et al. (1994)
Lake Trout (Great Lakes)	TCDD	skin-off & cooked	61	Zabik & Zabik 1995
Lake Trout / Lean (Lake Huron)	p,p'-DDT	skin-off & baked	17	Zabik et al. 1996
	p,p'-DDT	skin-off & charbroiled	34	Zabik et al. 1996
	p,p'-DDE	skin-off & baked	18	Zabik et al. 1996
	p,p'-DDE	skin-off & charbroiled	9	Zabik et al. 1996
	p,p'-DDD	skin-off & baked	6	Zabik et al. 1996
	p,p'-DDD	skin-off & charbroiled	16	Zabik et al. 1996
	α- chlordane	skin-off & baked	7	Zabik et al. 1996
	α- chlordane	skin-off & charbroiled	18	Zabik et al. 1996
	γ- chlordane	skin-off & baked	83	Zabik et al. 1996
	γ- chlordane	skin-off & charbroiled	38	Zabik et al. 1996
	oxychlordane	skin-off & baked	6	Zabik et al. 1996
	oxychlordane	skin-off & charbroiled	12	Zabik et al. 1996
	cis-nonachlor	skin-off & baked	17	Zabik et al. 1996
	cis-nonachlor	skin-off & charbroiled	18	Zabik et al. 1996
	trans-nonachlor	skin-off & baked	19	Zabik et al. 1996
	trans-nonachlor	skin-off & charbroiled	16	Zabik et al. 1996
	HCB	skin-off & baked	15	Zabik et al. 1996
	HCB	skin-off & charbroiled	23	Zabik et al. 1996
	dieldrin	skin-off & baked	8	Zabik et al. 1996
	dieldrin	skin-off & charbroiled	30	Zabik et al. 1996
	heptachlor epoxide	skin-off & baked	4	Zabik et al. 1996
	heptachlor epoxide	skin-off & charbroiled	12	Zabik et al. 1996
	toxaphene	skin-off & baked	18 *	Zabik et al. 1996
toxaphene	skin-off & charbroiled	13	Zabik et al. 1996	
Total PCBs	skin-off & baked	18	Zabik et al. 1996	
Total PCBs	skin-off & charbroiled	15	Zabik et al. 1996	
Lake Trout / Lean (Lake Michigan)	p,p'-DDT	skin-off & baked	11	Zabik et al. 1996
	p,p'-DDT	skin-off & charbroiled	19	Zabik et al. 1996
	p,p'-DDE	skin-off & baked	9	Zabik et al. 1996
	p,p'-DDE	skin-off & charbroiled	14	Zabik et al. 1996
	p,p'-DDD	skin-off & baked	11	Zabik et al. 1996
	p,p'-DDD	skin-off & charbroiled	9	Zabik et al. 1996
	α- chlordane	skin-off & baked	4	Zabik et al. 1996
	α- chlordane	skin-off & charbroiled	3	Zabik et al. 1996
	γ- chlordane	skin-off & baked	2	Zabik et al. 1996

See footnotes at end of table.

(continued)

Table C-1. (Continued)

Species	Contaminant	Activity ^a	Reduction (%) ^b	Reference
Lake Trout / Lean (Lake Michigan) (con.)	γ - chlordane	skin-off & charbroiled	3	Zabik et al. 1996
	oxychlordane	skin-off & baked	11	Zabik et al. 1996
	oxychlordane	skin-off & charbroiled	11	Zabik et al. 1996
	cis-nonachlor	skin-off & baked	18	Zabik et al. 1996
	cis-nonachlor	skin-off & charbroiled	10	Zabik et al. 1996
	trans-nonachlor	skin-off & baked	2	Zabik et al. 1996
	trans-nonachlor	skin-off & charbroiled	9	Zabik et al. 1996
	HCB	skin-off & baked	19	Zabik et al. 1996
	HCB	skin-off & charbroiled	15	Zabik et al. 1996
	dieldrin	skin-off & baked	18	Zabik et al. 1996
	dieldrin	skin-off & charbroiled	7	Zabik et al. 1996
	heptachlor epoxide	skin-off & baked	12	Zabik et al. 1996
	heptachlor epoxide	skin-off & charbroiled	5	Zabik et al. 1996
	toxaphene	skin-off & baked	13	Zabik et al. 1996
	toxaphene	skin-off & charbroiled	15	Zabik et al. 1996
	Total PCBs	skin-off & baked	10	Zabik et al. 1996
	Total PCBs	skin-off & charbroiled	7	Zabik et al. 1996
	p,p'-DDT	skin-off & baked	12	Zabik et al. 1996
	p,p'-DDE	skin-off & baked	9	Zabik et al. 1996
	p,p'-DDD	skin-off & baked	11	Zabik et al. 1996
	α - chlordane	skin-off & baked	4	Zabik et al. 1996
	γ - chlordane	skin-off & baked	3 *	Zabik et al. 1996
	oxychlordane	skin-off & baked	11	Zabik et al. 1996
	cis-nonachlor	skin-off & baked	18	Zabik et al. 1996
	trans-nonachlor	skin-off & baked	2	Zabik et al. 1996
	HCB	skin-off & baked	19	Zabik et al. 1996
	dieldrin	skin-off & baked	18	Zabik et al. 1996
	heptachlor epoxide	skin-off & baked	12	Zabik et al. 1996
	toxaphene	skin-off & baked	13	Zabik et al. 1996
	Total PCBs	skin-off & baked	10	Zabik et al. 1996
	p,p'-DDT	skin-off & charbroiled	19	Zabik et al. 1996
	p,p'-DDE	skin-off & charbroiled	14	Zabik et al. 1996
	p,p'-DDD	skin-off & charbroiled	9	Zabik et al. 1996
	α - chlordane	skin-off & charbroiled	3	Zabik et al. 1996
	γ - chlordane	skin-off & charbroiled	3	Zabik et al. 1996
	oxychlordane	skin-off & charbroiled	11	Zabik et al. 1996
	cis-nonachlor	skin-off & charbroiled	10	Zabik et al. 1996
	trans-nonachlor	skin-off & charbroiled	9	Zabik et al. 1996
	HCB	skin-off & charbroiled	15	Zabik et al. 1996
	dieldrin	skin-off & charbroiled	7	Zabik et al. 1996
	heptachlor epoxide	skin-off & charbroiled	5	Zabik et al. 1996
	toxaphene	skin-off & charbroiled	15	Zabik et al. 1996
	Total PCBs	skin-off & charbroiled	7	Zabik et al. 1996
p,p'-DDT	skin-off & salt boiled	1 *	Zabik et al. 1996	
p,p'-DDE	skin-off & salt boiled	7	Zabik et al. 1996	
p,p'-DDD	skin-off & salt boiled	5	Zabik et al. 1996	
α - chlordane	skin-off & salt boiled	5	Zabik et al. 1996	

See footnotes at end of table.

(continued)

Table C-1. (Continued)

Species	Contaminant	Activity ^a	Reduction (%) ^b	Reference	
Lake Trout / Lean (Lake Michigan) (con.)	γ- chlordane	skin-off & salt boiled	1	Zabik et al. 1996	
	oxychlordane	skin-off & salt boiled	3	Zabik et al. 1996	
	cis-nonachlor	skin-off & salt boiled	10	Zabik et al. 1996	
	trans-nonachlor	skin-off & salt boiled	13	Zabik et al. 1996	
	HCB	skin-off & salt boiled	7	Zabik et al. 1996	
	dieldrin	skin-off & salt boiled	16	Zabik et al. 1996	
	heptachlor epoxide	skin-off & salt boiled	3	Zabik et al. 1996	
	toxaphene	skin-off & salt boiled	5	Zabik et al. 1996	
	Total PCBs	skin-off & salt boiled	10	Zabik et al. 1996	
	p,p'-DDT	skin-off & smoked	58	Zabik et al. 1996	
	p,p'-DDE	skin-off & smoked	47	Zabik et al. 1996	
	p,p'-DDD	skin-off & smoked	61	Zabik et al. 1996	
	α- chlordane	skin-off & smoked	50	Zabik et al. 1996	
	γ- chlordane	skin-off & smoked	49	Zabik et al. 1996	
	oxychlordane	skin-off & smoked	57	Zabik et al. 1996	
	cis-nonachlor	skin-off & smoked	51	Zabik et al. 1996	
	trans-nonachlor	skin-off & smoked	55	Zabik et al. 1996	
	HCB	skin-off & smoked	53	Zabik et al. 1996	
	dieldrin	skin-off & smoked	42	Zabik et al. 1996	
	heptachlor epoxide	skin-off & smoked	59	Zabik et al. 1996	
	toxaphene	skin-off & smoked	49	Zabik et al. 1996	
	Fluoranthene	skin-off & smoked	6782 *	Zabik et al. 1996	
	Total PCBs	skin-off & smoked	41	Zabik et al. 1996	
	Benzo[b]fluorene	skin-off & smoked	1170 *	Zabik et al. 1996	
	3,6-Dimethylphenanthrene	skin-off & smoked	1245 *	Zabik et al. 1996	
	Benz[a]anthracene	skin-off & smoked	5582 *	Zabik et al. 1996	
	Chrysene	skin-off & smoked	4086 *	Zabik et al. 1996	
	Total PAHs	skin-off & smoked	10058 *	Zabik et al. 1996	
	Lake Trout / Lean (Lake Ontario)	p,p'-DDT	skin-off & baked	12	Zabik et al. 1996
		p,p'-DDT	skin-off & charbroiled	8	Zabik et al. 1996
p,p'-DDE		skin-off & baked	12	Zabik et al. 1996	
p,p'-DDE		skin-off & charbroiled	12	Zabik et al. 1996	
p,p'-DDD		skin-off & baked	85	Zabik et al. 1996	
p,p'-DDD		skin-off & charbroiled	88	Zabik et al. 1996	
HCB		skin-off & baked	10	Zabik et al. 1996	
HCB		skin-off & charbroiled	17	Zabik et al. 1996	
dieldrin		skin-off & baked	4	Zabik et al. 1996	
dieldrin		skin-off & charbroiled	8	Zabik et al. 1996	
toxaphene		skin-off & baked	71	Zabik et al. 1996	
Total PCBs		skin-off & baked	11	Zabik et al. 1996	
Total PCBs		skin-off & charbroiled	12	Zabik et al. 1996	
Lake Trout Siscowet/ High Fat Content (Lake Superior)		p,p'-DDT	skin-off & baked	42	Zabik et al. 1996
	p,p'-DDT	skin-off & charbroiled	72	Zabik et al. 1996	
	p,p'-DDE	skin-off & baked	20	Zabik et al. 1996	
	p,p'-DDE	skin-off & charbroiled	10	Zabik et al. 1996	
	p,p'-DDD	skin-off & baked	20	Zabik et al. 1996	

See footnotes at end of table.

(continued)

Table C-1. (Continued)

Species	Contaminant	Activity ^a	Reduction (%) ^b	Reference
Lake Trout	p,p'-DDD	skin-off & charbroiled	14	Zabik et al. 1996
Siscowet/ High Fat Content (Lake Superior) (con.)	α- chlordane	skin-off & baked	10	Zabik et al. 1996
	α- chlordane	skin-off & charbroiled	6	Zabik et al. 1996
	γ- chlordane	skin-off & baked	12	Zabik et al. 1996
	γ- chlordane	skin-off & charbroiled	29 *	Zabik et al. 1996
	oxychlordane	skin-off & baked	9	Zabik et al. 1996
	oxychlordane	skin-off & charbroiled	18	Zabik et al. 1996
	cis-nonachlor	skin-off & baked	17	Zabik et al. 1996
	cis-nonachlor	skin-off & charbroiled	21	Zabik et al. 1996
	trans-nonachlor	skin-off & baked	9	Zabik et al. 1996
	trans-nonachlor	skin-off & charbroiled	18	Zabik et al. 1996
Lake Trout	TCDF	skin-off & baked	16	Zabik et al. 1996
High Fat Content/ Siscowet (Lake Superior) (con.)	TCDF	skin-off & charbroiled	24	Zabik et al. 1996
	dieldrin	skin-off & baked	15	Zabik et al. 1996
	dieldrin	skin-off & charbroiled	16	Zabik et al. 1996
	heptachlor epoxide	skin-off & baked	57	Zabik et al. 1996
	heptachlor epoxide	skin-off & charbroiled	3 *	Zabik et al. 1996
	toxaphene	skin-off & baked	28	Zabik et al. 1996
	toxaphene	skin-off & charbroiled	45	Zabik et al. 1996
	Total PCBs	skin-off & baked	18	Zabik et al. 1996
	Total PCBs	skin-off & charbroiled	32	Zabik et al. 1996
	p,p'-DDT	skin-off & baked	42	Zabik et al. 1996
	p,p'-DDE	skin-off & baked	20	Zabik et al. 1996
	p,p'-DDD	skin-off & baked	17	Zabik et al. 1996
	α- chlordane	skin-off & baked	10	Zabik et al. 1996
	γ- chlordane	skin-off & baked	12	Zabik et al. 1996
	oxychlordane	skin-off & baked	9	Zabik et al. 1996
	cis-nonachlor	skin-off & baked	17	Zabik et al. 1996
	trans-nonachlor	skin-off & baked	9	Zabik et al. 1996
	TCDF	skin-off & baked	16	Zabik et al. 1996
	dieldrin	skin-off & baked	15	Zabik et al. 1996
	heptachlor epoxide	skin-off & baked	57	Zabik et al. 1996
	toxaphene	skin-off & baked	28	Zabik et al. 1996
	Total PCBs	skin-off & baked	18	Zabik et al. 1996
	p,p'-DDT	skin-off & charbroiled	72	Zabik et al. 1996
	p,p'-DDE	skin-off & charbroiled	10	Zabik et al. 1996
	p,p'-DDD	skin-off & charbroiled	14	Zabik et al. 1996
	α- chlordane	skin-off & charbroiled	6	Zabik et al. 1996
	γ- chlordane	skin-off & charbroiled	29 *	Zabik et al. 1996
	oxychlordane	skin-off & charbroiled	18	Zabik et al. 1996
	cis-nonachlor	skin-off & charbroiled	21	Zabik et al. 1996
	trans-nonachlor	skin-off & charbroiled	18	Zabik et al. 1996
	TCDF	skin-off & charbroiled	24	Zabik et al. 1996
	dieldrin	skin-off & charbroiled	16	Zabik et al. 1996
	heptachlor epoxide	skin-off & charbroiled	3 *	Zabik et al. 1996
	toxaphene	skin-off & charbroiled	45	Zabik et al. 1996

See footnotes at end of table.

(continued)

Table C-1. (Continued)

Species	Contaminant	Activity ^a	Reduction (%) ^b	Reference
Lake Trout	Total PCBs	skin-off & charbroiled	32	Zabik et al. 1996
Siscowet/ High Fat Content (Lake Superior) (con.)	p,p'-DDT	skin-off & salt boiled	16	Zabik et al. 1996
	p,p'-DDE	skin-off & salt boiled	25	Zabik et al. 1996
	p,p'-DDD	skin-off & salt boiled	18	Zabik et al. 1996
	α- chlordane	skin-off & salt boiled	24	Zabik et al. 1996
	γ- chlordane	skin-off & salt boiled	28	Zabik et al. 1996
	oxychlordane	skin-off & salt boiled	22	Zabik et al. 1996
	cis-nonachlor	skin-off & salt boiled	11	Zabik et al. 1996
	trans-nonachlor	skin-off & salt boiled	13	Zabik et al. 1996
	HCB	skin-off & salt boiled	38	Zabik et al. 1996
	dieldrin	skin-off & salt boiled	12	Zabik et al. 1996
	heptachlor epoxide	skin-off & salt boiled	10	Zabik et al. 1996
	toxaphene	skin-off & salt boiled	17	Zabik et al. 1996
	Total PCBs	skin-off & salt boiled	19	Zabik et al. 1996
	p,p'-DDT	skin-off & smoked	61	Zabik et al. 1996
	p,p'-DDE	skin-off & smoked	42	Zabik et al. 1996
	p,p'-DDD	skin-off & smoked	44	Zabik et al. 1996
	α- chlordane	skin-off & smoked	43	Zabik et al. 1996
	γ- chlordane	skin-off & smoked	40	Zabik et al. 1996
	oxychlordane	skin-off & smoked	63	Zabik et al. 1996
	cis-nonachlor	skin-off & smoked	45	Zabik et al. 1996
	trans-nonachlor	skin-off & smoked	45	Zabik et al. 1996
	HCB	skin-off & smoked	46	Zabik et al. 1996
	dieldrin	skin-off & smoked	41	Zabik et al. 1996
	heptachlor epoxide	skin-off & smoked	35	Zabik et al. 1996
	toxaphene	skin-off & smoked	44	Zabik et al. 1996
	Total PCBs	skin-off & smoked	37	Zabik et al. 1996
	Phenathrene	skin-off & smoked	10771 *	Zabik et al. 1996
	Anthracene	skin-off & smoked	2677 *	Zabik et al. 1996
	Fluoranthene	skin-off & smoked	29654 *	Zabik et al. 1996
	Pyrene	skin-off & smoked	5928 *	Zabik et al. 1996
	Benzo[b]fluorene	skin-off & smoked	255 *	Zabik et al. 1996
	3,6-	skin-off & smoked	1260 *	Zabik et al. 1996
	Dimethylphenanthrene			
	Benz[a]anthracene	skin-off & smoked	915 *	Zabik et al. 1996
	Dibenz[ac]anthracene	skin-off & smoked	259 *	Zabik et al. 1996
	Dibenzo[ae]pyrene	skin-off & smoked	157 *	Zabik et al. 1996
	Dibenzo[ah]pyrene	skin-off & smoked	8 *	Zabik et al. 1996
	Chrysene	skin-off & smoked	421 *	Zabik et al. 1996
	Total PAHs	skin-off & smoked	4173 *	Zabik et al. 1996
Smallmouth Bass	DDE	Trimming	54	Skea et al. (1979)
	DDE	Baking	16	Skea et al. (1979)
	DDE	Frying	75	Skea et al. (1979)
	Mirex	Trimming	64	Skea et al. (1979)
	Mirex	Baking	21	Skea et al. (1979)
	Mirex	Frying	75	Skea et al. (1979)
	Mirex	Trimming & cooking	80	Skea et al. (1979)

See footnotes at end of table.

(continued)

Table C-1. (Continued)

Species	Contaminant	Activity ^a	Reduction (%) ^b	Reference
Smallmouth Bass (con.)	PCB	Trimming	64	Skea et al. (1979)
	PCB	Baking	16	Skea et al. (1979)
	PCB	Frying	74	Skea et al. (1979)
	PCB	Trimming & cooking	80	Skea et al. (1979)
White Bass (Great Lakes)	TCDD	skin-on & cooked	approx. 80	Zabik & Zabik 1995
Walleye	DDT	Skin-on & baking	4	Zabik et al. (1994)
	DDT	Skin-on & charbroiling	16	Zabik et al. (1994)
	DDT	Skin-on & deep frying	11	Zabik et al. (1994)
	α-Chlordane	Skin-on & baking	32	Zabik et al. (1994)
	α-Chlordane	Skin-on & charbroiling	33	Zabik et al. (1994)
	α-Chlordane	Skin-on & deep frying	-25	Zabik et al. (1994)
	Dieldrin	Skin-on & baking	3	Zabik et al. (1994)
	Dieldrin	Skin-on & charbroiling	3	Zabik et al. (1994)
	Dieldrin	Skin-on & deep frying	26	Zabik et al. (1994)
	PCB	Skin-on & baking	17	Zabik et al. (1994)
	PCB	Skin-on & charbroiling	24	Zabik et al. (1994)
	PCB	Skin-on & deep frying	14	Zabik et al. (1994)
	Toxaphene	Skin-on & baking	45	Zabik et al. (1994)
Walleye (Great Lakes)	TCDD	skin-on & cooked	approx. 44	Zabik & Zabik 1995
Walleye (Lake Erie)	Chlordane Complex	skin-on & baked	33	Zabik et al. 1995a
	DDT Complex	skin-on & baked	33	Zabik et al. 1995a
	Dieldrin	skin-on & baked	21	Zabik et al. 1995a
	Total PCBs	skin-on & baked	13	Zabik et al. 1995a
	Chlordane Complex	skin-on & charbroiled	60	Zabik et al. 1995a
	DDT Complex	skin-on & charbroiled	25	Zabik et al. 1995a
	Dieldrin	skin-on & charbroiled	29	Zabik et al. 1995a
	Total PCBs	skin-on & charbroiled	20	Zabik et al. 1995a
Walleye (Lake Huron)	Chlordane Complex	skin-on & baked	44	Zabik et al. 1995a
	DDT Complex	skin-on & baked	26	Zabik et al. 1995a
	Dieldrin	skin-on & baked	10	Zabik et al. 1995a
	Total PCBs	skin-on & baked	20	Zabik et al. 1995a
	Chlordane Complex	skin-on & charbroiled	25	Zabik et al. 1995a
	DDT Complex	skin-on & charbroiled	17	Zabik et al. 1995a
	Dieldrin	skin-on & charbroiled	37	Zabik et al. 1995a
	Total PCBs	skin-on & charbroiled	29	Zabik et al. 1995a
Walleye (Lake Michigan)	Chlordane Complex	skin-on & baked	9	Zabik et al. 1995a
	DDT Complex	skin-on & baked	22	Zabik et al. 1995a
	Dieldrin	skin-on & baked	26	Zabik et al. 1995a
	Total PCBs	skin-on & baked	23	Zabik et al. 1995a
	Chlordane Complex	skin-on & charbroiled	33	Zabik et al. 1995a
	DDT Complex	skin-on & charbroiled	33	Zabik et al. 1995a
	Dieldrin	skin-on & charbroiled	12	Zabik et al. 1995a
	Total PCBs	skin-on & charbroiled	27	Zabik et al. 1995a
	Chlordane Complex	skin-on & deep fat fried	3	Zabik et al. 1995a
	DDT Complex	skin-on & deep fat fried	3	Zabik et al. 1995a

See footnotes at end of table.

(continued)

Table C-1. (Continued)

Species	Contaminant	Activity ^a	Reduction (%) ^b	Reference
Walleye (con.) (Lake Michigan)	Dieldrin	skin-on & deep fat fried	27	Zabik et al. 1995a
	Total PCBs	skin-on & deep fat fried	15	Zabik et al. 1995a
Five species (Great Lakes)	trichloro-PCB	skin-on & baked	approx. 15	Zabik & Zabik 1996
	trichloro-PCB	skin-off & baked	approx. 20	Zabik & Zabik 1996
	tetrachloro-PCB	skin-on & baked	approx. 26	Zabik & Zabik 1996
	tetrachloro-PCB	skin-off & baked	approx. 26.5	Zabik & Zabik 1996
	pentachloro-PCB	skin-on & baked	approx. 32	Zabik & Zabik 1996
	pentachloro-PCB	skin-off & baked	approx. 29	Zabik & Zabik 1996
	hexachloro-PCB	skin-on & baked	approx. 34	Zabik & Zabik 1996
	hexachloro-PCB	skin-off & baked	approx. 34.5	Zabik & Zabik 1996
	heptachloro-PCB	skin-on & baked	approx. 34.75	Zabik & Zabik 1996
	heptachloro-PCB	skin-off & baked	approx. 33	Zabik & Zabik 1996
	octachloro-PCB	skin-on & baked	approx. 27	Zabik & Zabik 1996
	octachloro-PCB	skin-off & baked	approx. 25	Zabik & Zabik 1996
	Total PCBs	skin-on & baked	approx. 34	Zabik & Zabik 1996
	Total PCBs	skin-off & baked	approx. 33	Zabik & Zabik 1996
	trichloro-PCB	skin-on & charbroiled	approx. 28	Zabik & Zabik 1996
	trichloro-PCB	skin-off & charbroiled	approx. 26	Zabik & Zabik 1996
	tetrachloro-PCB	skin-on & charbroiled	approx. 32	Zabik & Zabik 1996
	tetrachloro-PCB	skin-off & charbroiled	approx. 34	Zabik & Zabik 1996
	pentachloro-PCB	skin-on & charbroiled	approx. 36	Zabik & Zabik 1996
	pentachloro-PCB	skin-off & charbroiled	approx. 33	Zabik & Zabik 1996
	hexachloro-PCB	skin-on & charbroiled	approx. 40	Zabik & Zabik 1996
	hexachloro-PCB	skin-off & charbroiled	approx. 35	Zabik & Zabik 1996
	heptachloro-PCB	skin-on & charbroiled	approx. 40	Zabik & Zabik 1996
	heptachloro-PCB	skin-off & charbroiled	approx. 37	Zabik & Zabik 1996
	octachloro-PCB	skin-on & charbroiled	approx. 28	Zabik & Zabik 1996
	octachloro-PCB	skin-off & charbroiled	approx. 31	Zabik & Zabik 1996
	Total PCBs	skin-on & charbroiled	approx. 37	Zabik & Zabik 1996
	Total PCBs	skin-off & charbroiled	approx. 36	Zabik & Zabik 1996

^a Skin-on refers to the trimming of only the belly flap; skin-off refers to the removal of the belly flap as well as the lateral line and associated fat tissue.

^b Data from the Zabik et al. (1994) study were condensed by averaging contaminant reductions across lakes whenever a fish species was sampled from more than one of the Great Lakes.

Table C-2. Summary of Contaminant Reductions Due to Skinning, Trimming, and Cooking (Based on Standard Fillet, Whole Fish or Other Fillet)

Species	Contaminant	Activity	Reduction (%) ^a	Reference
American Shad	DDT/DDE	Trimming	40	NYSDEC (1981)
	PCB	Trimming	44	NYSDEC (1981)
Bluefish	PCB	Trimming	59	Armbruster et al. (1989) ^c
	PCB	Baking	8	Armbruster et al. (1989) ^c
	PCB	Broiling	8	Armbruster et al. (1989) ^c
	PCB	Frying	8	Armbruster et al. (1989) ^c
	PCB	Poaching	8	Armbruster et al. (1989) ^c
	PCB	Trimming & cooking	67	Armbruster et al. (1989) ^c
Chinook Salmon	Mirex	Trimming	15	NYSDEC (1981)
	PCB	Trimming	25	NYSDEC (1981)
	PCB (1248)	Trimming & baking	15	Smith et al. (1973)
	PCB (1248)	Trimming & poaching	-1	Smith et al. (1973)
	PCB (1254)	Trimming and baking	-1	Smith et al. (1973)
	PCB (1254)	Trimming & poaching	2	Smith et al. (1973)
Coho Salmon	DDT	Trimming	62	Reinert et al. (1972)
	DDT/DDE	Trimming	53	NYSDEC (1981)
	DDT	Dressing	0	Reinert et al. (1972)
	Mirex	Trimming	21	NYSDEC (1981)
	PCB	Trimming	32	NYSDEC (1981)
	PCB (1248)	Trimming & baking	4	Smith et al. (1973)
	PCB (1248)	Trimming & poaching	-9	Smith et al. (1973)
	PCB (1254)	Trimming & baking	-10	Smith et al. (1973)
	PCB(1254)	Trimming & poaching	-14	Smith et al. (1973)
	Dieldrin	Roasted	25	Zabik et al. (1994)
Dieldrin	Microwave	47	Zabik et al. (1994)	
Lake Trout	DDT	Trimming	54	Reinert et al. (1972)
	DDT/DDE	Trimming	46	NYSDEC (1981)
	DDT	Dressing	0	Reinert et al. (1972)
	DDT	Frying	64-72	Reinert et al. (1972)
	DDT	Broiling	64-72	Reinert et al. (1972)
	DDT	Broiling	39	Zabik et al. (1994)
	DDT	Roasted	30	Zabik et al. (1994)
	DDT	Microwave	54	Zabik et al. (1994)
	Dieldrin	Broiling	48	Zabik et al. (1994)
	Mirex	Trimming	50	NYSDEC (1981)
	PCB	Trimming	50	NYSDEC (1981)
Perch	DDT	Dressing	90	Reinert et al. (1972)
Winter Flounder (Seafish)	PCB	Deep frying	47	EPA (1992)
	PCB	Pan frying	-15	EPA (1992)
	PCB	Broiling	-17	EPA (1992)

^a It could not be positively determined that reduction figures were calculated as changes in contaminant concentrations from the standard fillet.

^b Average of findings reported in New York State Department of Environmental Conservation (1981) and White et al. (1985).

^c Averages of findings reported in Armbruster et al. (1989).

Table C-3. Average Contaminant Reductions Due to Cooking in Great Lakes Fish ^a

Chemical Contaminant	Reduction (%)
p,p'-DDT	34.0
p,p'-DDE	29.4
p,p'-DDD	29.0
α-Chlordane	34.8
γ-Chlordane	33.0
Oxychlordane	35.6
<i>cis</i> -Nonachlor	35.7
<i>trans</i> -Nonachlor	27.9
Dieldrin	28.7
Heptachlor epoxide	35.6
Toxaphene	36.5
Total PCBs	30.3

^a Processing involved trimming the belly flap area for skin-on fillets and skinning and removing fatty tissue from the belly flap area and the lateral line for skin-off fillets.

Source: Zabik et al. (1994).

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