

Table 1A

Location and fish characteristics for analyses of OCPs, PCBs and BFRs: Sampling time, mean and range of individual length and number of pooled liver samples from wild (sites 1,2 & 3) and farmed (farm 1 & 2) tilapia from Lake Kariba, Zambia. Gender: all males.

Location	Sampling time 2017	Mean individual length (cm)	Range of individual length (cm)	No. of individual samples	No. of fish per pool	No. of pooled samples
Site 1 Sinazongwe	June	27	20-41	18	3	6
Site 2 Gwembe	June	29	24-37	16	2-3	6
Site 3 Siavonga	July	30	22-47	16	2-3	6
Farm 1 Siavonga	July	26	18-34	14	2-3	6
Farm 2 Siavonga	July	36	30-40	18	3	6

Table 1B

Location and fish characteristics for analyses of PFASs: Sampling time, mean and range of individual length and number of pooled liver samples from wild (sites 1,2 & 3) and farmed (farm 1 & 2) tilapia from Lake Kariba, Zambia.

Location	Sampling time 2017	Mean individual length (cm)	Range of individual length (cm)	N	Gender Female/male
Site 1 Sinazongwe	June	29	26-34	5	3/2
Site 2 Gwembe	June	36	32-42	5	2/3
Site 3 Siavonga	July	27	24-30	6	0/6
Farm 1 Siavonga	July	28	26-30	5	1/4
Farm 2 Siavonga	July	26	25-29	5	n.d.

n.d.= not documented

Table 2A: Concentration (ng/g wet weight (ww) of persistent organic pollutants in wild (sites 1, 2 and 3) and farmed tilapia (farms 1 and 2) from Lake Kariba, Zambia.

Location		W _w						
		Lipid %	HCB	ΣHCH	ΣDDTS	ΣCHLs	Σ ₁₇ PCBs	Σ ₁₀ PBDEs
Site 1	Mean	6.77	0.02	0.03	6.88	0.01	0.18	0.14
	Median	4.17	0.01	0.01	4.20	0.01	0.15	0.16
	Min	2.77	0.01	0.01	1.38	<LOD	0.04	0.01
	Max	18.66	0.05	0.08	15.7	0.03	0.34	0.27
	N = 6							
Site 2	Mean	4.73	0.01	0.02	4.67	0.01	0.02	0.36
	Median	4.92	0.01	0.02	3.68	0.004	0.02	0.31
	Min	2.91	0.01	0.01	1.36	<LOD	0.01	0.13
	Max	6.45	0.01	0.02	10.1	0.02	0.03	0.63
	N = 6							
Site 3	Mean	7.82	0.02	0.05	2.16	0.01	0.08	0.14
	Median	7.15	0.02	0.04	1.51	0.01	0.07	0.09
	Min	6.53	0.01	0.02	0.88	<LOD	0.03	0.06
	Max	11.37	0.03	0.12	6.10	0.05	0.16	0.32
	N = 6							
Farm 1	Mean	8.09	0.01	0.03	0.94	0.01	0.03	0.11
	Median	7.51	0.01	0.03	0.91	0.01	0.01	0.11
	Min	6.26	0.01	0.01	0.51	<LOD	0.02	0.07
	Max	12.31	0.02	0.06	1.35	0.01	0.03	0.16
	N = 6							
Farm 2	Mean	9.44	0.01	0.02	0.62	0.004	0.02	0.04
	Median	8.77	0.01	0.02	0.55	0.004	0.01	0.03
	Min	7.62	0.01	0.01	0.31	<LOD	0.01	0.02
	Max	13.72	0.02	0.02	1.06	0.01	0.04	0.07
	N = 6							

Σ -HCHs: Sum of α -, β - and γ -HCHs

Σ -CHLs: Sum of oxychlordane, trans-chlordane, cis-chlordane, trans-nonachlor and cis-nonachlor

Σ -DDTs: Sum of *p,p'*-DDE, *o,p'*-DDD, *p,p'*-DDD, *o,p'*-DDT and *p,p'*-DDT

Σ_{17} PCBs: Sum of CB-101, -105, -110, -118, -128, -138, -141, -149, -151, -153, -156, -170, -180, -183, -194, -206 and -209

Σ_{10} PBDEs: Sum of BDE-47, -99, -100, -153, -154, -183, -196, -202, -206 and -209

Table 2B: Concentration (ng/g lipid weight (lw) of persistent organic pollutants in wild (sites 1, 2 and 3) and farmed tilapia (farms 1 and 2) from Lake Kariba, Zambia.

Location		n (6)	Lw						
			Lipid %	HCb	ΣHCH	ΣDDTS	ΣCHLs	Σ ₁₇ PCBs	Σ ₁₀ PBDEs
Site 1	Mean		6.77	0.32	0.17	97.52	0.13	3.26	2.48
	Median		4.17	0.24	0.10	92.51	0.14	3.18	2.52
	Min		2.77	0.17	<LOD	47.98	<LOD	0.74	<LOD
	Max		18.66	0.60	0.42	173.03	0.27	6.55	5.21
	N=6								
Site 2	Mean		4.73	0.21	0.33	98.14	0.10	0.36	9.24
	Median		4.92	0.22	0.26	80.72	0.09	0.25	8.03
	Min		2.91	0.14	<LOD	46.64	<LOD	0.06	2.05
	Max		6.45	0.26	0.72	219.22	0.23	1.02	21.16
	N=6								
Site 3	Mean		7.82	0.27	0.68	24.73	0.14	0.89	1.75
	Median		7.15	0.24	0.52	20.34	0.11	0.94	1.36
	Min		6.53	0.18	0.28	13.13	<LOD	0.41	0.77
	Max		11.37	0.40	1.74	53.62	0.40	1.40	3.27
	N=6								
Farm 1	Mean		8.09	0.13	0.21	8.12	0.04	0.14	0.51
	Median		7.51	0.12	0.21	7.48	0.03	0.08	0.49
	Min		6.26	0.09	0.13	4.57	<LOD	<LOD	0.20
	Max		12.31	0.21	0.28	15.55	0.09	0.50	0.97
	N=6								
Farm 2	Mean		9.44	0.10	0.36	9.93	0.04	0.23	1.21
	Median		8.77	0.09	0.33	10.01	0.04	0.22	1.19
	Min		7.62	0.08	<LOD	6.54	<LOD	0.11	0.71
	Max		13.72	0.13	0.67	12.30	0.06	0.37	1.96
	N=6								

Σ -HCHs: Sum of α -, β - and γ -HCHs

Σ -CHLs: Sum of oxychlordan, trans-chlordan, cis-chlordan, trans-nonachlor and cis-nonachlor

Σ -DDTs: Sum of *p,p'*-DDE, *o,p'*-DDD, *p,p'*-DDD, *o,p'*-DDT and *p,p'*-DDT

Σ_{17} PCBs: Sum of CB-101, -105, -110, -118, -128, -138, -141, -149, -151, -153, -156, -170, -180, -183, -194, -206 and -209

Σ_{10} PBDEs: Sum of BDE-47, -99, -100, -153, -154, -183, -196, -202, -206 and -209

Table 3: Mean concentrations (ng/g ww), median (in brackets) and range of PFAS compounds detected in wild and farmed tilapia from Lake Kariba, Zambia.

PFAS compound	Location				
	Site 1 (n=5)	Site 2 (n=5)	Site 3 (n=6)	Farm 1 (n=5)	Farm 2 (n=5)
PFOS	0.643 (0.658) 0.46-0.859 5/5	0.423 (0.139) <LOD-0.866 2/5	<LOD	<LOD	<LOD
PFNA	0.185 (0.194) <LOD-0.274 1/5	0.235 (0.135) <LOD-0.677 1/5	<LOD	<LOD	<LOD
PFDA	0.301 (0.313) 0.221-0.374 5/5	0.478 (0.367) <LOD-1.18 4/5	<LOD	<LOD	<LOD

PFOS: perfluorooctane sulfonate

PFNA: perfluorononanoic acid

PFDA: perfluorodecanoic acid

Table 4: Environmental quality standards (EQS) for contaminants in fish and median levels (expressed as ng/g wet weight (ww), (dioxin-like PCBs, DL-PCBs as pg/g TEQs ww) in wild and farmed (grouped and individual) tilapia from Lake Kariba, Zambia,

Contaminant	EU EQS	Present study		
		Median wild fish, site S1 & S2 (long distance from the farms)	Wild fish, site 3 (near farms)	Farmed fish Farm F1 and F2
DDT		3.93	1.51	0.75
HCB	10	0.012	0.02	0.01
γ -HCH	-	0.009	0.02	0.02
Mirex	-	-	-	-
CHL	-	0.003	0.01	0.003
Heptachlor and heptachlor epoxide	0.0067	-	-	-
PCBs	0.6	0.04	0.07	0.015
DL-PCB: PCB-118*	6.5	S1:0.42; S2:0.06	0.15	F1:0.03; F2:0.03
HBCDD	167	-	-	-
PBDEs	0.0085	0.13	0.08	0.02
PFOS	9.1	0.40	-	-

*: pg TEQ/g ww

Table 5: Comparison of mean concentrations (ng/g lw) of persistent organic pollutants in tilapia and other fish species from various countries.

Country	Location	Sample	Lipid%	HCB	ΣHCH	p,p'-DDE	p,p'-DDT	ΣDDTs	DDE/DDT	ΣCHLs	ΣPCBs	ΣPBDEs	ΣHBCDD	References
Zambia	Wild S1 <i>Oreochromis niloticus</i>	Liver	6.77	0.32	0.35	52.3	6.88	97.95	17	0.15	3.31	2.56	<LOD	Current study
	Wild S2		4.73	0.21	0.42	64.4	2.0	98.14	60	0.12	0.47	9.3	<LOD	
	Wild S3		7.82	0.26	0.7	12.2	2.37	24.94	5.8	0.15	0.93	1.77	<LOD	
Zambia	Farm F1 <i>Oreochromis niloticus</i>	Liver	9.44	0.10	0.38	3.07	0.54	9.96	20	0.05	0.28	1.24	<LOD	Current study
	Farm F2		8.09	0.13	0.24	2.41	0.08	8.2	32	0.05	0.21	0.55	0.05	
Zimbabwe	Caged <i>Oreochromis</i> spp	Muscle		<LOD	0.3	4.2	1.5	6.9						(Berg et al., 1992)
Zimbabwe	Wild <i>Oreochromis</i> spp	Muscle		0.5	0.4	26	2.4	31.9						(Berg et al., 1992)
Zimbabwe	Pond <i>Tilapia rendalli</i>	Muscle		0.1	0.4	4.1	1.7	6.7						(Berg et al., 1992)
Zimbabwe	Wild <i>Tilapia rendalli</i>	Muscle		0.2	0.6	14.7	4.3	21.1						(Berg et al., 1992)
Tanzania	Pond <i>Chanos chanos</i>	Liver	7.98	0.22	0.05	13.5	3.2	16.60			1.47	1.64	<LOD	(Mwakalapa. et al., 2018)
Tanzania	Indian ocean <i>Chanos chanos</i>	Liver	7.81	0.20	0.10	103	2.50	177	41		0.20	1.30	<LOD	(Mwakalapa. et al., 2018)
Tanzania	Indian ocean <i>Mugil Cephalus</i>	Liver	4.85	0.20	0.04	60.7	2.2	73.3	35		0.6	1.10	5.20	(Mwakalapa. et al., 2018)
Tanzania (LT)	<i>Oreochromis niloticus</i>	Muscle	3.30	1.20	1.10	116	41.8	273	2.8	0.90	17.2	4.10		(Polder et al., 2014)
Tanzania (LV)	<i>Oreochromis niloticus</i>	Muscle	0.4	2.5	<LOD	27.1	1.4	34.7	9.4	0.5	12	34.4	<LOD	(Polder et al., 2014)
Tanzania (LN)	<i>Oreochromis niloticus</i>	Muscle	1.9	2.1	1.2	7.1	4.4	13.2	1.7	<LOD	0.7	6.5	<LOD	(Polder et al., 2014)
Tanzania (LB)	<i>Oreochromis niloticus</i>	Muscle	4.1	0.9	<LOD	28.9	2.1	42.7	3.7	<LOD	0.1	1.5	2.4	(Polder et al., 2014)
Tanzania	<i>Oreochromis niloticus</i>	Muscle	1.50					500						(Henry and Kishimba, 2006)
Tanzania	<i>Oreochromis urolepis</i>	Muscle	8.00	2.50		25.0	21.3	46.3		2.50				(Mdegela et al., 2009)
DR Congo	<i>Distichodus fasciolatus</i>	Muscle	1.2	0.02	0.04			0.14			0.89	0.2		(Verhaert et al., 2013)
South Africa	<i>Oreochromis mossambicus</i>	Muscle	0.98		34.7			520		10.2	<LOD	<LOD		(Verhaert et al., 2017)
South Africa	<i>Hydrocynus vittatus</i>	Muscle	3.83	117.5	12.9	4,162	937	5,537		2.9	532	5.8		(Wepener et al., 2012)
Ethiopia	<i>Oreochromis niloticus</i>	Muscle						6.90			0.05			(Deribe et al., 2011)
Uganda	<i>Oreochromis niloticus</i>											5.6		(Ssebugere et al., 2014)
Ghana	<i>Oreochromis niloticus</i>	Muscle	2.8		41.6	0.15	0.53	10.7		4.02				(Gbeddy. et al., 2015)
Ghana	<i>Oreochromis niloticus</i>	Muscle	1.9								54	7.1	0.75	(Asante et al., 2013)
Norway	Femunden <i>Salmo trutta</i>	Muscle	3	18.1							108	28	15	(Lycke et al., 2018)

<LOD: less than limit of detection

LT-Lake Tanganyika, LV- Lake Victoria, LN-Lake Nyasa and LB-Lake Babati.