Reference	Species	Experiment Type/Treatment	MIE 227	KE 807	KE 1756	KE 1758	AO 2147	AO 360
			Activation, PPARα	**Decreased, cholesterol**	**Decreased, plasma 11-ketotestosterone level**	**Impaired, Spermatogenesis**	**Decreased, Viable offspring**	**Decrease, Population growth rate**
Ning et al. 2017	Nile tilapia (*Oreochromis niloticus*)	200 mg fenofibrate/kg BW for 4 weeks [adults]	not measured, exposure to known PPARa agonist	total Chl decreased [HDL increased, no change in LDL]				
Prindiville et al. 2011	Rainbow trout (*Oncorhynchus mykiss*)	100 mg gemfibrozil/kg BW every 3 days for 15 days [juvenile]	not measured, exposure to known PPARa agonist	total Chl decreased [HDL, LDL, VLDL dcreased]				
Lee et al. 2019	Japanese medaka (*Oryzias latipes*)	0.04 - 3.7 mg gemfibrozil /L for 155 days (embryos) or 21 days (adults)	not measured, exposure to known PPARa agonist	no change in embryos or adult females, decreased in adult males (in all concentrations)	11-KT decreased in highest 2 concentrations, but not lowest conc.			
Al-Habsi et al. 2016	Zebrafish (*Danio rerio*)	16 mg gemfibrozil/kg BW per day for 30 days [adult]	increased PPARa mRNA abundance (in females only)	total Chl decreased (males and females)				
Velasco-Santamaría et al. 2011	Zebrafish (*Danio rerio*)	1.7, 33, and 70 mg bezafibrate/g food (35, 667, & 1428 mg /kg BW) for 48 hours, 7 days, & 21 days [adult]	not measured, exposure to known PPARa agonist	total Chl decreased (in highest 2 concentration at 7 days, all concentrations at 21 days)	11-KT decreased (only in in highest concentration after 21 days)	testicular degeneration; increased syncytia and spermatocytes		
Du et al. 2008	Grass carp (*Ctenopharyngodon idella*)	100 mg fenofibrate/kg BW per day for 2 weeks, fed high fat diet [juvenile]	not measured, exposure to known PPARa agonist	total Chl decreased [HDL no change, LDL decreased]				
Guo et al. 2015	Grass carp (*Ctenopharyngodon idella*)	50 mg clofibrate/kg BW per day for 4 weeks, fed high fat diet or high carbohydrate diet [adult]	not measured, exposure to known PPARa agonist	total Chl decreased [HDL, LDL decreased]				
Runnalls et al. 2007	Fathead minnow (*Pimephales promelas*)	1 mg/L clofibric acid for 21 days [adult]	not measured, exposure to known PPARa agonist	total Chl decreased in females, not sig. in males; no sig change in HDL or LDL		decrease in # sperm per mg gonad, increase in # of non-viable sperm/mg gonad (sperm count, quality, velocity)		
Urbatzka et al. 2015	Turbot (*Scophthalmus maximus*)	5 or 50 mg WY-14,643/kg BW for 7 or 21 days [juvenile]	not measured, exposure to known PPARa agonist	total Chl decreased [HDL decreased]				
Fraz et al. 2018	Zebrafish (*Danio rerio*) - ex vivo	10 ug/L Gemfibrozil, with and without 25OH-cholestrerol	not measured, exposure to known PPARa agonist		11-KT decreased unless supplemented with 25OH-cholesterol			
Agulleiro et al. 2007	Senegalese sole (*Solea senegalensis*)	Treated with saline (control) or with 50 µg/kg GnRHa, with or without another implant containing 2 or 7 mg/kg 11-ketoandrostenedione for 28 days			11-KT increased with GnRHa + OA	lower number of spermatogonia and spermatocytes and a higher number of spermatids than those of GnRHa or control		
Amer et al. 2001	Japanese huchen (*Hucho perryi*)	Incubated immature testis fragments			treated with 11-KT 10 ng/ml for 15 days	BrdU (proliferation marker) index reached 34.5% ± 1.7%; percentage of late type B spermatogonia reached about 7.5% compared to 0% in control		
Cavaco et al. 2001	African catfish (*Clarias gariepinus*)	Males implanted with pellets containing 30 µg/g body weight of 11-KT [juvenile]			30 µg/g body weight of 11-KT; plasma 11-KT levels reached 8.3 ± 0.6 ng/ml after 2 weeks	GSI increased compared to control; testicular stage 1 (contain spermatogonia only) and 2 (contain spermatogonia and spermatocytes) increased from about 90% stage 1 and 10% stage 2 in end control to about 25% stage 1 and 75% stage 2		
Cavaco et al. 1998	African catfish (*Clarias gariepinus*)	Males at beginning of spermatogenesis implanted with pellets containing a) 30 µg/g body weight of 11-KT, b) 11β-hydroxyandrostenedione , or c) androstenetrione			Plasma 11-KT levels reached a) 6.1 ± 0.8 ng/ml after 2 weeks, b) 7.3 ± 0.7 ng/ml after 2 weeks, or c) 2.4 ± 0.3 ng/ml after 2 weeks	testicular stages changed from about 65% stage 1 and 35% stage 2 in the end control to 50-65% stages 2 and 35-50% stage 3 (contain spermatogoina, spermatocytes, and spermatids)		
Melo. et al. 2015	Atlantic salmon (*Salmo salar*)	Immature fish injected with 25 µg adrenosterone/g of body weight			Plasma 11-KT increased after 7 and 14 days	5-fold higher number of type A differentiated spermatogonia than control fish after 14 days (7-day samples lost - no data)		
Miura et al. 1991	Japanese eel (*Anguilla japonica*)	Immature testes or testis fragments cultured in media with 11-KT for up to 36 days			treated with 11-KT	mitosis occurred in 50-60% of cysts in highest 2 concentrations (10 and 100 ng/ml) in immature testes and progression in fragments at all timepoints measured		
Selvaraj et al. 2013	Chub mackerel (*Scomber japonicus*)	Peptide mix containing synthetic peptides corresponding to chub mackerel Kiss1-15 at a final concentration of 250 ng/g fish were injected 3 times at 2-week interval (immature adult)			11-KT increased	higher levels of spermatids and spermatozoa		
Ozaki et al. 2006	Japanese eel (*Anguilla japonica*)	Testicular fragment treated with 0.01 ng/ml cortisol			11-KT increased at (slight at 1 ng/ml, sig. at 100 ng/ml)	significant increase in BrdU Index compared to control		
Zhang et al. 2020	Zebrafish (*Danio rerio*)	*cyp11c1* knockout rescue via 11-ketoandrostenedione (11-KA) treatment			lacking cyp11c1 show dramatically reduced 11KT levels; treatment with 100 nM 11-KA for 4 hours per day for 10 days	lacking cyp11c1 show delayed spermatogenesis; Promoted the juvenile ovary-to-testis transition; genes associated with Leydig cell development/function restored; increased sperm volume		
Agbohessi et al. 2015	Guinean tilapia (*Tilapia guineensis*) & African catfish (*Clarias gariepinus*)	Fish from multiple sites contaminated with pesticides were studied			11-KT levels significantly lower in contaminated sites	amounts of spermatids and spermatozoa were decreased in contaminated sites		
Chen et al. 2017	Nile tilapia (*Oreochromis niloticus*)	Heterozygous mutation of eEF1A1b (eEF1A1b+/−) via CRISPR/Cas9 [eEF1A1b - elongation factor]			11-KT decreased at 90 and 180 days after hatch (dah)	absence of spermatocytes at 90 dah, and decreased number of spermatocytes, spermatids and spermatozoa at 180 dah	greatly reduced in vitro fertilization rate (5% compared to 80% in WT)	
de Waal et al. 2009	Zebrafish (*Danio rerio*)	Exposure to 10 nM 17β-estradiol (E2) via water for 6 or 21 days [adult]			11-KT Significantly decreased in ex vivo testicular production	Type B spermatogonia, primary and secondary spermatocytes, and spermatids significantly decreased		
Hatef et al. 2012	Goldfish (*Carassius auratus*)	30 day exposure to 100, 400, or 800 µg/L anti-androgen vinclozolin (VZ) water [adult]			11-KT increase at lowest conc, no change at mid, decrease at highest conc	at highest conc, Significant decrease (compared to control) in sperm volume, motility, and velocity; spermatozoa without flagella or with damaged flagella were observed		
Liu et al. 2018	Yellow catfish (*Pelteobagrus fulvidraco*)	Juvenile fish exposed to 10 ng/L or 100 ng/L DES for 28 days via water			11-KT slightly decreased (but significant)	loss of spermatids; presence of several lacunas		
Pereira et al. 2015	Nile tilapia (*Oreochromis niloticus*)	Sexually mature males exposed via water to 200 ng/L diuron or diuron metabolites (DCA, DCPU, or DCPMU) for 25 days [adult]			11-KT decrease of 11% to metabolites	in metabolites: Seminiferous tubules reduced about 60% and spermatid and spermatozoa amounts decreased by about 10% compared to control		
Sales et al. 2020	Adult male Nile tilapia (*Oreochromis niloticus*)	Starvation for 7-28 days [adult]			11-KT decreased at all time points	significant decrease in number of spermatocytes and spermatozoa , progressive greater impact over time		
Tang, et al. 2018	Zebrafish (*Danio rerio*)	Androgen receptor (*ar*) knockout			11-KT decreased in adult whole-body homogenate	reduced # of sperm, increased proportion of pre-spermatid sperm cells	reduced in vitro fertilization; failed to induce spawning	
Yin et al. 2017	Zebrafish (*Danio rerio*)	Males exposed for 30 days to 100 ng/L DES (estrogen), 300 um/L FLU (anti-androgen) or combination of both via water [adult]			11-KT decrased 2 to 6 fold	adverse effect on testicular development and spermatogenesis; sperm concentration decreased 3 to 4-fold		
Xia et al. 2018	Zebrafish (*Danio rerio*)	Genetic mutation to disrupt *mettl3*			11-KT decreased	reduced sperm motility; reduced # of mature sperm; increased spermatogonia and spermatocytes; decreased spermatozoa	decreased standard breeding rates	

Reference	Species	Experiment Type/Treatment	MIE 227 Activation, PPARα	KE 807 Decreased, cholesterol	KE 1756 Decreased, plasma 11-ketotestosterone level	KE 1758 Impaired, Spermatogenesis	AO 2147 Decreased, Viable offspring	AO 360 Decrease, Population growth rate
Chen et al., 2015	Zebrafish (*Danio rerio*)	1 nM BPA exposured for 2 continuous generations				decreased sperm density and quality	delayed hatching and increased malformation/mortality in offspring from BPA-exposed F2	
Corradetti et al., 2013	Zebrafish (*Danio rerio*)	Exposure to bis-(2-ethylexhyl) phthalate (DEHP; 0.2 or 20 µg/L) for three weeks [adult]				reduced testicular area with spermatocytes (and increase with spermatogonia)	decrease in embryo production (up to 90%) and lower hatch rate of embryos	
Dai et al., 2017	Zebrafish (*Danio rerio*)	Targeted genetic disruption of Tdrd12 [Tdrds (tudor domain-related proteins) have been demonstrated to be involved in spermatogenesis]				deformed and apoptotic spermatogonia; lack of spermatozoa at adult stage	infertile under standard breeding despite being able to induce female egg laying (0% fertilization)	
Hill and Janz, 2003	Zebrafish (*Danio rerio*)	Exposure to nonylphenol (NP: 10, 30, 100 ug/L) or ethinylestradiol (EE: 1, 10, 100 ng/L) for 2-60 days post-hatch				lack of differentiated gonadal tissue (EE) and several instances of ovatestes (NP)	reduction in viable eggs in 10 ng/L EE exposure (no data available for 100 ng/L EE treatment)	
Jobling et al., 2002	Roach (*Rutilus rutilus*)	mature fish collected from reference and effluent contaminated sites to be spawned in the laboratory [adult]				volume of milt reduced in intersex fish and lack of spermiation in some males	reduced fertilization rate in sperm from intersex males; decreased proportion of fertilized embryos reaching eyed stage and decreased hatching success with increased feminization	
Kang et al., 2002	Japanese medaka (*Oryzias latipes*)	Exposure to 17β-estradiol (E2; 29.3, 55.7, 116, 227, and 463 ng/L) for 21 days [adult males]				atrophy and degenerated spermatoza and spermacytes; oocytes and lack of normal testicular tissue observed with 463 ng/L E2	total number of eggs spawned and fertility reduced at 463 ng/L	
Leal et al., 2008	Zebrafish (*Danio rerio*)	*mlh1* mutation crossed out twice with wildtype (WT)				decrease in weight of spermatids and spermatozoa; increased apoptotic cells; increased spermatogenic stages prior to spermatids	reduced fertilization rates under standard breeding conditions; eggs fertilized from mutant sperm were malformed	
Ma et al., 2018	Zebrafish (*Danio rerio*)	Exposure to DEHP (10, 30, 100 ug/L) for 3 months				increase of spermatocytes and decrease of spermatids in highest exposure concentration	decreased fertilization rate	
Nash et al., 2004	Zebrafish (*Danio rerio*)	Exposure to ethynylestradiol (EE2: 0.5, 5 ng/L) or 17β-estradiol (E2: 5 ng/L) in multi-generational study				abnormal testes in all 5 ng/L EE2 exposed males	no fertilization in F1 in 5 ng/L EE2; higher proportion of nonviable eggs	
Oakes et al., 2019	Zebrafish (*Danio rerio*)	Genetic mutation to disrupt *fdx1b*				reduced sperm count	infertile (despite being able to induce egg laying) = 0% fertilization	
Saito et al., 2011	Zebrafish (*Danio rerio*)	Genetic mutations that lead to defects in gonadogenesis: *its*, *isa*, *imo*				spermatogensis arrested	decreased fertilization rates; infertile (despite being able to induce egg laying) = unfertilized eggs	
Saju et al., 2018	Zebrafish (*Danio rerio*)	Genetic mutations: HSF5 mutants				decrease of spermatozoa, increase in primary spermatocytes, decease in sperm count and motility	no viable offspring; lethality of embryos via in vitro fertilization	
Seki et al., 2002	Japanese medaka (*Oryzias latipes*)	Exposure to ethyinylestradiol (32.6, 63.9, 116, 261, 488 ng/L) for 21 days [adult]				abnormal testicular tissue, only a few serpmatozoa and spermatocytes	reduction in fertility, cessation of spawning at highest exposure concentraiton	
Uhrin et al., 2000	Mice	Genetic mutation to disrupt Protein C inhibitor				abnormal sperm morphology, reduced sperm motility	reduced in vivo fertilization rate with few oocytes fertilized and developed into blastocyst stage; infertile under standard breeding despite showing signs of normal sexual activity	
Uren-Webster et al., 2010	Zebrafish (*Danio rerio*)	Exposure to DEHP (0.5, 50, 5000 mg/kg body weight) for 10 days [adult]				reduced proportion of spermatozoa and increase in proportion of spermatocytes	reduced fertilization success of oocytes spawned by females	
Wang et al., 2016	Mice (C57BL/6)	Knockout of BRD7 for BRD7-deficient mice				development of elongating spermatids disrupted; increase in portion of abnormal spermatids	infertile under standard breeding despite showing signs of normal sexual activity	
Xie et al., 2020	Zebrafish (*Danio rerio*)	Genetic mutation to disrupt *E2f5*				arrested spermatogenesis (reducted # of spermatozoa, increased % of spermatocytes at early stages, arrested during prophase I); increased apoptosis	decreased fertilization rates under standard breeding conditions	
Ye et al., 2014	Marine medaka (*Oryzias melastigma*)	Exposure to DEHP (0.1, 0.5 mg/L) or MEHP (0.1, 0.5 mg/L) for 6 months from larval stage				contained mostly spermatocytes and spermatids with few spermatozoa	decreased fertilization success	

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