Table 1. *In Vivo*/Ex Vivo PPAR Activity of Medicinal Plants

Genus species	Actives	Type of compound	Model	Iso form	Dose	PPAR-α (Ki, Kd) or IC_{50}	PPAR-β/δ (Ki, Kd) or IC_{50}	PPAR-γ (Ki, Kd) IC_{50}	mRNA or protein	Author
Astragalus membranaceus, Morus alba, Crataegus pinnatifida, Alisma oriental, Salvia miltiorrhiza, Pueraria lobata	None	None	Fatty liver cells RT-PCR In vivo, Murine	α	2.000 g/kg/day 4 weeks	N/A	N/A	N/A	↑mRNA PPAR α	21
Barreria hispida			Heart tissue Oral Ex vivo, Murine	γδ	150 mg/kg/b.w.d. 30 days	N/A	N/A	N/A	↑PPAR γ δ protein	22
Camellia sinensis			Visceral and subcutaneous fat Western Blot In vivo, Canine	γ	80 mg/kg/d 12 weeks	N/A	N/A	N/A	↑mRNA PPAR γ,α	23
Camellia sinensis			Liver Western Blot In vivo, Canine	α	80 mg/kg/d 12 weeks	N/A	N/A	N/A	↑mRNA PPAR α	23
Camellia sinensis		Catechin rich	Hepatic Oral In vivo, Murine	α	50 mL/day 28 days	N/A	N/A	N/A	↑PPAR α protein	24
Capparis decidua	Alkaloid rich fraction		Liver, kidney, muscle, adipose tissue Oral Ex vivo, Murine	γ	50 mg/kg 28 days	N/A	N/A	N/A	↑PPAR γ protein	25
Cinnamoni cassiae			Adipose tissue In vivo, Murine	γ	400 mg/kg/d 3 weeks RT-PCR	N/A	N/A	N/A	↑PPAR γ protein	26
Cinnamoni cassiae			Liver tissue In vivo, Murine	α	400 mg/kg/d 3 weeks RT-PCR	N/A	N/A	N/A	↑PPAR α protein	26
Cnidium monnieri	Osthole		Hepatic tissue In vivo, Murine	αγ	20 mg/kg Western blot 6 weeks	N/A	N/A	N/A	↑PPAR γα protein	27
Cnidium monnieri	Osthole		Hepatic tissue In vivo, Murine	αγ	5,10 mg/kg Western blot 6 weeks	N/A	N/A	N/A	↓PPAR γα protein	27
Commiphora mukul	guggulsterone		3T3 L1 cells Oral	γ	75 mg/kg 16 weeks	N/A	N/A	N/A	↑PPAR γ protein	28

			In vivo, Murine							
*Corni fructus**	7-O-galloyl-d-sediheptulose		Hepatic tissue Oral Ex vivo, Murine	α	10 and 20 mg/kg 20 days	N/A	N/A	N/A	↑PPAR α protein	[29]
Glycine max	Isoflavones depleted		Skeletal Muscle Oral Ex vivo, Monkey	γα	75 mg/day 10 weeks	N/A	N/A	N/A	↑PPAR γ, α protein	[30]
Helicteres Isora		Saponins	Adipose tissue Oral In vivo, Murine	γ	100 mg/kg 14 days	N/A	N/A	N/A	↑PPAR γ protein	[31]
Ilex paraguarionsis			Brown adipose tissue Oral Ex vivo, Murine	γ	1.0 mg/kg Daily 8 weeks	N/A	N/A	N/A	↑PPAR γ 2 protein	[32]
Juglans regia			Hepatic cells Oral In vivo, Murine	α	50,100,& 200 mg/kg 13 days	N/A	N/A	N/A	↑PPAR α mRNA	[33]
Lagerstroemia speciosa	None	None	Liver and adipose tissue Ex vivo, Murine	α,γ	0.5% of diet 12 weeks	N/A	N/A	N/A	↑mRNA PPAR-α; ↑ mRNA PPAR-γ	[34]
Leguminosidae	Phytoestrogen	Isoflavonoids	Ki67 stroma cells Oral In vivo, Murine	γ	100 mg/kg/d 4days	N/A	N/A	N/A	↓PPAR γ Protein	[35]
Momordica charantia		Ethyl acetate	Hepatoma cell line H4IIEC3 In vivo, Murine	α	100 µg/mL	N/A	N/A	N/A	↑PPARα protein	[36]
Momordica charantia		n Hexane	Hepatoma cell line H4IIEC3 In vivo, Murine	α	100, 150 µg/mL	N/A	N/A	N/A	↑PPARα protein	[36]
Momordica charantia	45-57 fraction Fatty acid	nHexane	Hepatoma cell line H4IIEC3 H NMR spectra In vivo, Murine	α	50 µg/mL	N/A	N/A	N/A	↑PPARα protein	[36]
Momordica charantia	20-24 fraction triglyceride hydrolysate	n Hexane	Hepatoma cell line H4IIEC3 H NMR Spectra In vivo, Murine	α	50 µg/mL	N/A	N/A	N/A	↑PPARα protein	[36]
Momordica charantia	17-60 fraction	N Hexane	Hepatoma cell line	α	25, 50 µg/mL	N/A	N/A	N/A	↑PPARα	Chuang [36] et

	triglyceride hydrolysate		H4IIEC3 H NMR spectra In vivo, Murine						protein	al, 2006
Momordica charantia	9 cis, 11 trans 13 trans conjugated linolenic acid	N Hexane	Hepatoma cell line H4IIEC3 H NMR spectra In vivo, Murine	α	180 μM	N/A	N/A	N/A	↑PPARα protein	[36]
Momordica charantia	P fraction G fraction		Adipose tissue In vivo, Murine	γ	1.0 g/kg b.w./d 4 weeks Rt-PCR	N/A	N/A	N/A	↑PPAR γ mRNA	[37]
Momordica charantia	P fraction G fraction		Liver cells In vivo, Murine	α	P-0.5&1.0 g/kg b.w./d G-0.2&1.0 g/kg b.w./d 4 weeks Rt-PCR	N/A	N/A	N/A	↑PPAR α mRNA	[37]
Moordica charantia	Fraction P2 and G2		White adipose tissue Oral In vivo, Murine	γ	1.0 g/kg/bwd 2 weeks	N/A	N/A	N/A	↑PPARγ protein	[38]
Morus alba	None	None	Liver and adipose tissue Ex vivo, Murine	α,γ	0.5% of diet 12 weeks	N/A	N/A	N/A	↑mRNA PPAR-α; ↑ mRNA PPAR-γ	[34]
Morus alba, Panax ginseng, Lagerstroemia speciosa 1:1:1 ratio	None	None	Liver and adipose tissue Ex vivo, Murine	α,γ	0.5% of diet 12 weeks	N/A	N/A	N/A	↑mRNA PPAR-α; ↑ mRNA PPAR-γ	[34]
Ob-X:Morus alba, Melissa officinalis, Artemisia caprillas			Liver cells Northern Blot In vivo, Murine	α	0.18 g/Murine/day 12 weeks	N/A	N/A	N/A	↑mRNA PPAR α	[39]
Panax ginseng	None	None	Liver and adipose tissue Ex vivo, Murine	α,γ	0.5% of diet 12 weeks	N/A	N/A	N/A	↑mRNA PPAR-α; ↑ mRNA PPAR-γ	[34]
Panax ginseng			Adipose tissue In vivo, Murine	γ	200 mg/kg b.w./d 4 weeks	N/A	N/A	N/A	↑PPAR γ mRNA	[40]
Panax ginseng radix palva			KKAy adipocyte cells Western blot	γ	500 mg/kg qd 28 days	N/A	N/A	N/A	↑PPAR γ protein	[41]

			In vivo, Murine							
Persimmon	Polymer and Oligomers	Proanthocyanidin	Hepatic cells In vivo, Murine	α	10 mg/kg b.w./d 6 weeks Wester blot	N/A	N/A	N/A	↑PPAR α protein	[42]
Pinella terrata	None	None	White adipose tissue Ex vivo, Murine	α	400 mg/kg Qd 6wks	N/A	N/A	N/A	mRNA ↑PPAR α mRNA ↑PGC1 α	[43]
Prunus cerasus			Liver cells Oral In vivo, Murine	α	1% powder 90 days	N/A	N/A	N/A	↑PPAR α mRNA	[44]
Prunus mume	ekisu	Phenolic	Wister fat In vivo, Murine	γ	0.25% and 1% Qd 2wks	N/A	N/A	N/A	↑mRNA PPAR γ	[45]
Punica granatum			Zucker diabetic fatty cells RT-PCR In vivo, Murine	α	500 mg/kg qd 5wks	N/A	N/A	N/A	↑mRNA PPAR α	[46]
Punica granatum			Zucker diabetic fatty cells RT-PCR In vivo, Murine	γ	500 mg/kg qd 6wks	N/A	N/A	N/A	↑mRNA PPAR γ	[47]
Punica granatum			F334 colon cells Western blot In vivo, Murine	γ	0.01%, 0.1% and 1% qd 32wks	N/A	N/A	N/A	↑PPAR γ Protein	[48]
Punica granatum			Hepatic cells Oral In vivo, Murine	α	500 mg/kg/d 6 weeks	N/A	N/A	N/A	↑PPAR α mRNA	[49]
Punica granatum	Punicic acid		Abdominal WAT Oral In vivo, Murine	α	1 g/100 g diet 90 days	N/A	N/A	N/A	↑PPAR α protein	[50]
Punica granatum	Punicic acid		Abdominal WAT Oral In vivo, Murine	γ	1 g/100 g diet 90 days	N/A	N/A	N/A	↑PPAR γ protein	[50]
Punica granatum	Punicic acid		Skeletal muscle Oral In vivo, Murine	γ	1 g/100 g diet 90 days	N/A	N/A	N/A	↑PPAR γ protein	[50]
Rhizoma coptidis	Berberine	Alkaloids	Liver Oral In vivo, Murine	αδγ	150 & 300 mg/kg/d 16 weeks	N/A	N/A	N/A	↑PPAR α, δ Protein ↓PPAR γ Protein	[51]

Salacia oblonga			Zucker diabetic fatty cells TRIzol In vivo, Murine	α	100 mg/kg qd 6wks	N/A	N/A	N/A	↓PPAR α Protein	[52]
Salacia oblonga			Zucker diabetic fatty cells RT-PCR In vivo, Murine	α	100 mg/kg qd 6wks	N/A	N/A	N/A	↓mRNA PPAR α	[52]
Salacia oblonga			Hepatic cells Oral In vivo, Murine	α	100 mg/kg/d 6 weeks	N/A	N/A	N/A	↑PPAR α Protein, mRNA	[53]
shenqi			Adipose cells Oral In vivo, Murine	γ	0.72 g/kg &2.88 g/kg 32 days	N/A	N/A	N/A	↑PPAR γ mRNA	[54]
Spermacoce hispida	Flavonoid fraction	polyphenol	Hepatic cells Oral In vivo, Murine	α	40 mg/kg/bwd 45 days	N/A	N/A	N/A	↑PPAR α mRNA	[55]
Swietenia mahagony	multi-component	EtOAc Fraction	in vivo diabetic murine x 14 d	γ	1000 mg/kg	N/A	N/A	N/A	decreased blood glucose	[56]
Testudinis plastrum, Smilax glabra, Taraxacum mongolicum, Dictamus dasycarpus, Forsythia suspense, Kochia scoparia, Glycyrrhiza uralensis, Aristolochia manshuriensis	None	None	3T3-L1 cells RT-PCR In vivo, Human	γ	12.5% 7 days incubation	N/A	N/A	N/A	↑ mRNA PPAR-γ	[57]
Tong-xin-luo			Left ventricular myocardium Western Blot In vivo, Murine	γ	1.5 mg/kg/d 7 weeks Oral, capsules	N/A	N/A	N/A	↑PPAR γ Protein	[58]
Tong-xin-luo			Left ventricular myocardium PCR In vivo, Murine	γ	1.5 mg/kg/d 7 weeks Oral, capsules	N/A	N/A	N/A	↑mRNA PPAR γ	[58]
Zingiber officinale	Zingerone	Pyrolytic	Kidney cells Oral In vivo, Murine	αβγ	2 and 8 mg/kg 10 days	N/A	N/A	N/A	↑PPAR γαβ protein	[59]

Table 2. *In Vitro* PPAR Activity of Medicinal Plants

Genus species	Actives	Type of compound	Model	Iso form	Concentration	PPAR-α (Ki, Kd) or IC_{50}	PPAR-β/δ (Ki, Kd) or IC_{50}	PPAR-γ (Ki, Kd) IC_{50}	mRNA or protein	Author
Aeglas marmelos			L6 myotubes cells, RT-PCR, In vitro, unspecified	γ	100 ng/mL	N/A	N/A	N/A	↑mRNA PPAR γ	[60]
Astragalus membraneus	Polysaccharides		3T3-L1 adipocyte cells, RT-PCR In vitro, unspecified	γ	0.1 µg/µL	N/A	N/A	N/A	↑mRNA PPAR γ	[61]
Astragalus membranus	Astragaloiside IV		Adipose tissue RT-PCR In vitro, Murine	γ	10, 30 µg/mL	N/A	N/A	N/A	↑mRNA PPAR γ	[62]
Bai Hu Tang			HuH-7 hepatoma cells Incubation In vitro, Human	γ	0.8 µg/mL 24hours	N/A	N/A	N/A	↑PPAR γ protein	[63]
Cannabis sativa	Delta9-tetrahydro cannabinol	Cannabinoid	HEK293 cells In vitro, Murine	γ	100 nM, 1 µM, 10 µM	N/A	N/A	N/A	↑PPAR γ Protein (luciferase activity)	[64]
Chromolaena odorata	(9s,13r)-12-oxo-phytodienoic acid	prostaglandin	NIH 3T3 cells Incubation In vitro, Murine	γ	4.0 mcg/mL 16 hours	N/A	N/A	N/A	↑PPAR γ protein	[65]
Cinnamoni cassiae			3T3-L1 cells Incubated In vitro, Murine	αγ	0.6 mg/mL Day 5 RT-PCR	N/A	N/A	N/A	↑PPAR γα protein	[26]
Cinnamoni cassiae			3T3-L1 cells Incubated In vitro, Murine	γ	DM+CE 0.6 mg/mL Day 5 Western blot	N/A	N/A	N/A	↑PPAR γ protein	[26]
Cinnamoni cassiae			293T cells Incubation In vitro, murine	αγ	0.6 mg/mL 24 hours Full length	N/A	N/A	N/A	↑PPAR γα protein	[26]
Cinnamoni cassiae			293T cells	αγ	0.2 & 0.6	N/A	N/A	N/A	↑PPAR γα	[26]

			Incubation In vitro, murine		mg/mL 24 hours LBD				protein	
Citrus depressa	nobeletin	polymethoxyflavonoid	ST-13 cells preadipose Incubation In vitro, Murine	γ	10 & 30 μM 11 days	N/A	N/A	N/A	↑PPAR γ1,2 Protein	[66]
Clematis pickeringii	Fraction 3-4-16		HepG2 cells In vitro, unspecified	α	4,8,16 μg/mL	N/A	N/A	N/A	↑PPAR α Protein	[67]
Clematis pickeringii	Fraction 3-4-16		HepG2 cells In vitro, unspecified	γ	8,16 μg/mL	N/A	N/A	N/A	↑PPAR γ Protein	[67]
Commiphora mukul	guggulipid		COS7 cells Incubation In vitro, unspecified	α	N/A	0.82 μg/mL EC50	N/A	N/A	↑PPAR α protein	[68]
Commiphora mukul	Commipheric acid		COS7 cells Incubation In vitro, unspecified	α	N/A	0.26 μg/mL EC50	N/A	N/A	↑PPAR α protein	[68]
Commiphora mukul	guggulipid		COS7 cells Incubation In vitro, unspecified	γ	N/A	N/A	N/A	2.3 μg/mL EC50	↑PPAR γ protein	[68]
Commiphora mukul	Commipheric acid		COS 7 cells Incubation In vitro, unspecified	γ	N/A	N/A	N/A	0.66 μg/mL EC50	↑PPAR γ protein	[68]
Coryceps militaris			3T3-L1 cells Incubation In vitro, Murine	γ	0.05%-0.2% Northern blot 2 days	N/A	N/A	N/A	↓PPAR γ protein	[69]
Curcuma longa	Etoh		Adipocyte cells In vitro, Human	γ	5 and 10 μg/mL	N/A	N/A	N/A	↑PPAR γ Protein	[70]
Curcuma longa	curcumin, demethoxycurcumin, bisdemethoxycurcumin, and ar-turmerone,	Curcuminoids and Sesquiterpenoid	Adipocyte cells In vitro, Human	γ	2 and 5 μg/mL	N/A	N/A	N/A	↑PPAR γ Protein	[70]
Curcuma longa	Etoh extract		CV-1 cells In vitro,	γ	5 and 10 μg/mL	N/A	N/A	N/A	↑PPAR γ Protein	[71]

			unspecified							
Curcuma longa	curcumin, demethoxycurcumin, bisdemethoxycurcumin, and arturmerone	curcuminoids and sesquiterpenoids	CV-1 cells In vitro, unspecified	γ	2 and 5 µg/mL	N/A	N/A	N/A	↑PPAR γ Protein	[71]
Echinacea spp	Undecaenediynoic acid isobutylamide	Alkylamide	3T3-L1 cells Incubation In vitro, unspecified	γ	5,7.5,10 mcg/mL+insulin 10 mcg/mL 5 days	N/A	N/A	N/A	↑PPAR γ protein	Spelman K 2009
Epimedium	Icariin		Embryonic stem cells Incubation In vitro, Murine	α	10-7 mol/L Day 7-9 RT-PCR	N/A	N/A	N/A	↑PPAR α mRNA	[72]
Epimedium	Icariin		Embryonic stem cells Incubation In vitro, Murine	α	10-7 mol/L Day 8 Western blot	N/A	N/A	N/A	↑PPAR α protein	[72]
Epimedium	Icariin		Embryonic stem cells Incubation In vitro, Murine	α	10-7 & -8 mol/L Day 7-9 Western blot	N/A	N/A	N/A	↑PPAR α protein	[72]
Glycine max	Genistein	Isoflavones	HepG2 In vitro, unspecified	α□γ	1 µmol/L	4.3µmol/L EC_{50}	N/A	12 µmol/L EC_{50}	↑PPAR α ↑PPAR γ Full length (luciferase activity)	[73]
Glycine max	Genistein	Isoflavone	Umbilical vein endothelial cells In vitro, Human	γ	1 µM	N/A	N/A	N/A	↑PPAR γ protein	[74]
Glycyrrhiza glabra	Methyl 2-cyano-3,11-dioxo-18b-olean-1,12-dien-30-oate	Triterpenoid	3T3-L1 cells Oil Red O	γ	0.25 µM	N/A	N/A	N/A	↑PPAR γ protein	[75]
Glycyrrhiza glabra	Methyl 2-cyano-3,11-dioxo-18b-olean-1,12-dien-30-oate	Triterpenoid	Panc 28 cancer cells Incubation In vitro, Human	γ	2.5,5,7.5 µM 48 hrs GAL4 cells	N/A	N/A	N/A	↑PPAR γ protein	[75]
Glycyrrhiza glabra	Methyl 2-cyano-3,11-dioxo-18b-	Triterpenoid	Panc 1 cancer cells Incubation	γ	2.5,5,7.5 µM 48 hrs	N/A	N/A	N/A	↑PPAR γ protein	[75]

	olean-1,12-dien-30-oate		In vitro, Human		GAL4 cells					
Glycyrrhiza glabra	Methyl 2-cyano-3,11-dioxo-18b-olean-1,12-dien-30-oate	Triterpenoid	Panc 28 cancer cells Incubation In vitro, Human	γ	2.5,5,7.5 μM 48 hrs PPRE3 luc	N/A	N/A	N/A	↑PPAR γ protein	[75]
Glycyrrhiza glabra	Methyl 2-cyano-3,11-dioxo-18b-olean-1,12-dien-30-oate	Triterpenoid	Panc 1 cancer cells Incubation In vitro, Human	γ	5,7.5 μM 48 hrs PPRE3 luc	N/A	N/A	N/A	↑PPAR γ protein	[75]
Glycyrrhiza uralensis	Glycycoumarin Glycyrin	3-Arylcoumarins	CV-1 cells HPLC In vitro, Monkey	γ	1,2,5,10 mg/L	N/A	N/A	N/A	↑PPAR γ protein	[76]
Glycyrrhiza uralensis	Dehydroglyasperin C Dehydroglyasperin D	Isoflave-3-ens	CV-1 cells HPLC In vitro, Monkey	γ	1,2,5,10 mg/L	N/A	N/A	N/A	↑PPAR γ protein	[76]
Glycyrrhiza uralensis	Glycycoumarin Glycyrin	3-Arylcoumarins	CV-1 cells HPLC In vitro, Monkey	γ	5 mg/L	N/A	N/A	N/A	↑PPAR γ protein	[76]
Glycyrrhiza uralensis	Dehydroglyasperin C Dehydroglyasperin D	Isoflave-3-ens	CV-1 cells HPLC In vitro, Monkey	γ	5 mg/L	N/A	N/A	N/A	↑PPAR γ protein	[76]
Glycyrrhiza uralensis	Glycyrrhisoflavanone	Isoflavanones	CV-1 cells HPLC In vitro, Monkey	γ	5 mg/L	N/A	N/A	N/A	↑PPAR γ protein	[76]
Glycyrrhiza uralensis	Glicoricone Semilicoisoflavone B Glycyrrhisoflavone Licoricone Glyurallin B	Isoflavones	CV-1 cells HPLC In vitro, Monkey	γ	5 mg/L	N/A	N/A	N/A	↑PPAR γ protein	[76]
Glycyrrhiza uralensis	Liquiritin Liquiritigenin	Flavanones	CV-1 cells HPLC In vitro, Monkey	γ	5 mg/L	N/A	N/A	N/A	↑PPAR γ protein	[76]
Glycyrrhiza uralensis	Isoliquiritin Isoliquiritigenin	Chalcones	CV-1 cells HPLC In vitro, Monkey	γ	5 mg/L	N/A	N/A	N/A	↑PPAR γ protein	[76]
Glycyrrhiza uralensis	Glycyrol Isoglycyrol	Coumestans	CV-1 cells HPLC	γ	5 mg/L	N/A	N/A	N/A	↑PPAR γ protein	[76]

			In vitro, Monkey							
Glycyrrhiza uralensis	Licocoumarone Gancaonin I	2-Arylbenzofurans	CV-1 cells HPLC In vitro, Monkey	γ	5 mg/L	N/A	N/A	N/A	↑PPAR γ protein	[76]
Green tea seed oil			3T3-L1 cells Incubation In vitro, Murine	γ	0.1 & 1 mcg/mL 48 hours	N/A	N/A	N/A	↓PPAR γ2 Protein	[77]
Gynostemma pentaphyllum	Gyepnoside XLIX	Gynosaponin	HEK293 cells In vitro, Human	α	1, 10, 50, 100, 250, 500 μM	10.06 μM EC50			↑PPAR α Protein (luciferase activity)	[78]
Gynostemma pentaphyllum	Gyepnoside XLIX	Gynosaponin	THP-1 cells RT-PCR In vitro, Human	α	10, 100 and 300 μM	N/A	N/A	N/A	↑PPAR α Protein (luciferase activity) ↑mRNA PPAR α	[78]
Hibicsus sabdariffa		anthocyanin	J774A.1 cells macrophages Incubation In vitro, Murine	γ	0.05,0.1,0.2 mcg/mL 6 hours +25 mcg/mL oxLDL	N/A	N/A	N/A	↓PPAR γ Protein	[79]
Juglans regia	Pedunculagin	polyphenol	HepG2 cells Incubation In vitro, Murine	α	1,3,& 10 mcg/mL 48 hours	N/A	N/A	N/A	↓PPAR α mRNA	[33]
Juglans regia	Tellimagrendin I	polyphenol	HepG2 cells	α	1 mcg/mL 48 hours	N/A	N/A	N/A	↓PPAR α mRNA	[33]
Juglans regia	Ellagic acid	polyphenol	Incubation In vitro, Murine	α	10 mcg/mL 48 hours	N/A	N/A	N/A	↓PPAR α mRNA	[33]
Juglans regia			HepG2 cells Incubation In vitro, Murine	α	1 and 100 mcg/mL 48 hours	N/A	N/A	N/A	↑PPAR α mRNA	[33]
Juglans regia			HepG2 cells Incubation In vitro, Murine	α	10 mcg/mL 48 hours	N/A	N/A	N/A	↓PPAR α mRNA	[33]
Juniperus chinensis			Blood Oral In vitro, Murine	γ	1% 79 days	N/A	N/A	N/A	↓PPAR γ2 Protein	[80]
Kochujang			3T3-L1 adipocyte cells, RT-PCR In vitro, Murine	γ	1 mg/mL	N/A	N/A	N/A	↓mRNA PPAR γ	[81]
Lagerstroemia speciosa	None	Induced by IN-IBMX-DEX	3T3-L1 cells Adipocytes	γ 2	0.1, 0.3 g/L	N/A	N/A	N/A	↓mRNA PPAR γ 2	[82]

			In vitro unspecified							
mangosteen		Xanthones- γ	Adipose Incubation In vitro, Human	γ	3 μmol/L Plus LPS 10 mcg/mL 24 hours	N/A	N/A	N/A	PPAR γ mRNA prevented the suppression of	[83]
Momordica charantia/Actin			Caco-2 cells In vitro, Human	γ	10,25 μM	N/A	N/A	N/A	↑mRNA PPAR γ	[84]
Ob-X:Morus alba, Melissa officinalis, Artemisia caprillas			Nmu2Li cells Incubation In vitro, Murine	α	10 mcg/mL 24 hours	N/A	N/A	N/A	↑mRNA PPAR α	[39]
Origanum vulgare	quercitin	polyphenolic	Polar screen	γ	N/A	N/A	N/A	3.0 μM	↑PPAR γ protein binding	[85]
Origanum vulgare	luteolin	polyphenolic	Polar screen	γ	N/A	N/A	N/A	7.2 μM	↑PPAR γ protein binding	[85]
Origanum vulgare	Rosmarinic acid	polyphenolic	Polar screen	γ	N/A	N/A	N/A	32.4 μM	↑PPAR γ protein binding	[85]
Origanum vulgare	diosmetin	polyphenolic	Polar screen	γ	N/A	N/A	N/A	13 μM	↑PPAR γ protein binding	[85]
Origanum vulgare	naringenin	polyphenolic	NIH 3T3 cells Incubation In vitro, unspecified	γ	N/A	N/A	N/A	79.5 μM EC 50	↑PPAR γ protein transactivation	[85]
Origanum vulgare	apigenin	polyphenolic	NIH 3T3 cells Incubation In vitro, unspecified	γ	N/A	N/A	N/A	201.1 μM EC50	↑PPAR γ protein transactivation	[85]
Origanum vulgare	Biochanin a	polyphenolic	NIH 3T3 cells Incubation In vitro, unspecified	γ	N/A	N/A	N/A	32.1 μM EC50	↑PPAR γ protein transactivation	[85]
Origanum vulgare	Rosmaric acid	polyphenolic	NIH 3T3 cells Incubation In vitro, unspecified	γ	N/A	N/A	N/A	43.0 μM EC50	↑PPAR γ protein transactivation	[85]
Origanum vulgare	luteolin	polyphenolic	TR-FRET	γ	N/A	N/A	N/A	4.9 μM	↑PPAR γ protein transactivation	[85]

Origanum vulgare	isoquercetrin	polyphenolic	TR-FRET	γ	N/A	N/A	N/A	15.1 μM	↑PPAR γ protein transactivation	[85]
Origanum vulgare	quercetin	polyphenolic	TR-FRET	γ	N/A	N/A	N/A	3.7 μM	↑PPAR γ protein transactivation	[85]
Origanum vulgare	vitexin	polyphenolic	TR-FRET	γ	N/A	N/A	N/A	30.6 μM	↑PPAR γ protein transactivation	[85]
Origanum vulgare	Rosmarinic acid	polyphenolic	TR-FRET	γ	N/A	N/A	N/A	43.6 μM	↑PPAR γ protein transactivation	[85]
Origanum vulgare	eriodictyol	polyphenolic	TR-FRET	γ	N/A	N/A	N/A	16.1 μM	↑PPAR γ protein transactivation	[85]
Origanum vulgare	taxifolin	polyphenolic	TR-FRET	γ	N/A	N/A	N/A	75.7 μM	↑PPAR γ protein transactivation	[85]
Origanum vulgare	naringenin	polyphenolic	TR-FRET	γ	N/A	N/A	N/A	35.3 μM	↑PPAR γ protein transactivation	[85]
Origanum vulgare And Origanum onites Different varities			Morphological and DNA analysis	γ	N/A	N/A	N/A	1.6 to 500 μg/mL	↑PPAR γ protein binding	[85]
Panax ginseng	Ginsenosides Rf		NMu2Li cells In vitro, unspecified	α	10 μM	N/A	N/A	N/A	↓PPAR α Protein	[86]
Paullinia pinnata			Cos7-cells In vitro, unspecified	α	0.1 g/L	N/A	N/A	N/A	↑PPAR α protein	[87]
Petalonia binghamiae			Cos-1 cells Incubation In vitro, Murine	γ	10 μg/mL 24hours	N/A	N/A	N/A	↑PPAR γ Protein	[88]
Phellinus ribis	Chlorophellin A-C	Polychlorinate	NIH 3T3L-1 cells Incubation In vitro, unspecified	γ	10 μM 24 hours	N/A	N/A	N/A	↑PPAR γ protein	[89]
Poria cocos	Dehydrotrametenolic acid	Triterpene acid	3T3-L1 cells In vitro, Murine	γ	10^{-5},10^{-6} M	N/A	N/A	N/A	↑ PPAR γ protein (luciferase activity)	[90]
Poria cocos	Pachymic acid	Triterpene acid	3T3-L1 cells In vitro,	γ	10^{-5},10^{-6} M	N/A	N/A	N/A	↑ PPAR γ protein	[90]

			Murine						(luciferase activity)	
Pseudolarix kaempferi	Pseudolaric acid B		CV-1 cells In vitro, Mammalian	γ	10^{-5},10^{-4},10^{-3} M	N/A	N/A	N/A	↑PPAR γ Protein (luciferase activity)	[91]
Pseudolarix kaempferi	Pseudolaric acid G		CV-1 cells In vitro, Mammalian	γ	10^{-4},10^{-3} M	N/A	N/A	N/A	↑PPAR γ Protein (luciferase activity)	[91]
Pseudolarix kaempferi	Pseudolaric acid B		CV-1 cells In vitro, Mammalian	δ	10^{-5},10^{-4}M	N/A	N/A	N/A	↑PPAR δ Protein (luciferase activity)	[91]
Punica granatum			HepG cells Incubation In vitro, Human	α	10,50,100 mcg/mL 48 hours	N/A	N/A	N/A	↑PPAR α mRNA	[49]
Punica granatum	Punicic acid		3T3-L1 cells Incuation In vitro, unspecified	α	5 μM 24 hours	N/A	N/A	N/A	↑PPAR α protein Luciferase	[50]
Punica granatum	Pomegranate seed oil		3T3-L1 cells Incuation In vitro, unspecified	α	10 μg/mL 24 hours	N/A	N/A	N/A	↑PPAR α protein Luciferase	[50]
Punica granatum	Punicic acid		3T3-L1 cells Incuation In vitro, unspecified	γ	1.25,2.5,5,10 μM 24 hours	N/A	N/A	N/A	↑PPAR γ protein Luciferase	[50]
Punica granatum	Pomegranate seed oil		3T3-L1 cells Incuation In vitro, unspecified	γ	2.5,5,10 μg/mL 24 hours	N/A	N/A	N/A	↑PPAR γ protein Luciferase	[50]
Punica granatum	Punicic acid		3T3-L1 cells Incuation In vitro, unspecified	γ	N/A	N/A	N/A	2.5 μM	↑PPAR γ protein LBD transactivation	[50]
Rhizoma coptidis	Berberine		3T3-L1 adipocyte cells, RT-PCR In vitro, unspecified	γ	5 μmol/L	N/A	N/A	N/A	↓mRNA PPAR γ	[61]
Rhodiola rosea	Salidorside		3T3-L1 adipocyte cells, RT-PCR In vitro,	γ	1 mg/L	N/A	N/A	N/A	↓mRNA PPAR γ	[92]

			unspecified							
Romarinus officinalis, Salvia officinalis	Carnosic acid (this compound is from both herbs)		Cos7 cells In vitro, unspecified	γ	N/A	N/A	N/A	19.6 µM EC_{50}	↑PPAR γ Protein (luciferase activity)	[93]
Romarinus officinalis, Salvia officinalis	Carnosal (this compound is from both herbs)		Cos7 cells In vitro, unspecified	γ	N/A	N/A	N/A	41.2 µM EC_{50}	↑PPAR γ Protein (luciferase activity)	[93]
Rosmarinus officinalis	R1		Cos7 cells In vitro, unspecified	γ	N/A	N/A	N/A	22.8 mg/L EC_{50}	↑PPAR γ Protein (luciferase activity)	[93]
Rosmarinus officinalis	R2		Cos7 cells In vitro, unspecified	γ	N/A	N/A	N/A	34.1 mg/L EC_{50}	↑PPAR γ Protein (luciferase activity)	[93]
Salvia officinalis	S1		Cos7 cells In vitro, unspecified	γ	N/A	N/A	N/A	33.7mg/L EC_{50}	↑PPAR γ Protein (luciferase activity)	[93]
Salvia officinalis	S2		Cos7 cells In vitro, unspecified	γ	N/A	N/A	N/A	35.0 mg/L EC_{50}	↑PPAR γ Protein (luciferase activity)	[93]
Saururus chinensis	Saurufuran A	Acyclic Furanditerpene	NIH-3T3 cell In vitro, unspecified	γ	1-100 µM Dose dependent	N/A	N/A	14.9 µM EC_{50} (luciferase activity)	PPARγ binding	[94]
Saururus chinensis	Saurufuran B	Acyclic Furanditerpene	NIH-3T3 cells In vitro, unspecified	γ	1-100 µM Dose dependent	N/A	N/A	› 100 µM EC_{50} (luciferase activity)	PPARγ binding	[94]
Syzygium cumini			L6 myotubes cells, RT-PCR, In vitro, unspecified	γ	100 ng/ml	N/A	N/A	N/A	↑mRNA PPAR γ	[60]

Taiwanofungus comphoratus			COS-1 cells Incubation In vitro, Monkey	γ	10 mcg/mL 18 hrs Hot and cold water extract	N/A	N/A	N/A	↑PPAR γ Protein	[95]
Trifolium pratense	Biochanin A	Isoflavones	HepG2 In vitro, unspecified	α□γ	1 µmol/L	‹ 1.0 µmol/L EC_{50}	N/A	‹ 1.0 µmol/L EC_{50}	↑PPAR α ↑PPAR γ Full length (luciferase activity)	[73]
Trifolium pratense	Biochanin A	Isoflavones	3T3-L1 preadipocytes Using CYP496-ppre-luc	γ	3 µmol/L	N/A	N/A	N/A	↑PPAR γ protein (luciferase activity)	[73]
Trifolium pretense	Menoflavon forte	isoflavinoid	Polar screen	γ	N/A	N/A	N/A	26.8 µg/mL	↑PPAR γ protein binding	[96]
Trifolium pretense	Genistein	isoflavinoid	Polar screen	γ	N/A	N/A	N/A	19.6 µM	↑PPAR γ protein binding	[96]
Trifolium pretense	Biochanin A	isoflavinoid	Polar screen	γ	N/A	N/A	N/A	22.5 µM	↑PPAR γ protein binding	[96]
Trifolium pretense	6-hydroxydaidzein	metabolites	Polar screen	γ	N/A	N/A	N/A	3.3 µM	↑PPAR γ protein binding	[96]
Trifolium pretense	3-hydroxygenistein	metabolites	Polar screen	γ	N/A	N/A	N/A	12.2 µM	↑PPAR γ protein binding	[96]
Trifolium pretense	6-hydroxy-ODMA	metabolites	Polar screen	γ	N/A	N/A	N/A	16.7 µM	↑PPAR γ protein binding	[96]
Trifolium pretense	formononononectin	metabolites	Polar screen	γ	N/A	N/A	N/A	124.4 µM	↑PPAR γ protein binding	[96]
Trifolium pretense	dihydroformononetin	metabolites	Polar screen	γ	N/A	N/A	N/A	62.8 µM	↑PPAR γ protein binding	[96]
Trifolium pretense	angolensin	metabolites	Polar screen	γ	N/A	N/A	N/A	25.6 µM	↑PPAR γ protein binding	[96]
Trifolium pretense	equol	metabolites	Polar screen	γ	N/A	N/A	N/A	60.4 µM	↑PPAR γ	[96]

									protein binding	
Trifolium pretense	ODMA	metabolites	Polar screen	γ	N/A	N/A	N/A	66.9 μM	↑PPAR γ protein binding	[96]
Trifolium pretense	dihydrogenistein	metabolites	Polar screen	γ	N/A	N/A	N/A	76.8 μM	↑PPAR γ protein binding	[96]
Trifolium pretense	Biochanin a	metabolites	Polar screen	γ	N/A	N/A	N/A	89.7 μM	↑PPAR γ protein binding	[96]
Trifolium pretense	dihydodiadzein	metabolites	Polar screen	γ	N/A	N/A	N/A	204.0 μM	↑PPAR γ protein binding	[96]
Trifolium pretense	p-ethylphenol	metabolites	Polar screen	γ	N/A	N/A	N/A	269.1 μM	↑PPAR γ protein binding	[96]
Trifolium pretense	Menoflavon forte		NIH 3T3 cells Incubation In vitro, unspecified	γ	N/A	N/A	N/A	25.4 μg/mL EC 50 24 hours	↑PPAR γ protein transactivation	[96]
Trifolium pretense	Genistein	isoflavone	NIH 3T3 cells Incubation In vitro, unspecified	γ	N/A	N/A	N/A	18.7 μM EC50 24 hours	↑PPAR γ protein transactivation	[96]
Trifolium pretense	Biochanin A	isoflavone	NIH 3T3 cells Incubation In vitro, unspecified	γ	N/A	N/A	N/A	39.5 μM EC50 24 hours	↑PPAR γ protein transactivation	[96]
Trifolium pretense	Daidzein	isoflavone	NIH 3T3 cells Incubation In vitro, unspecified	γ	N/A	N/A	N/A	77 μM EC50 24 hours	↑PPAR γ protein transactivation	[96]
Trifolium pretense	ODMA	metabolite	NIH 3T3 cells Incubation In vitro, unspecified	γ	N/A	N/A	N/A	23.9% 24 hours	↑PPAR γ protein transactivation	[96]
Trifolium pretense	6-hydroxy-ODMA	metabolite	NIH 3T3 cells Incubation In vitro, unspecified	γ	N/A	N/A	N/A	21.2% 24 hours	↑PPAR γ protein transactivation	[96]
Trifolium pretense	6-hydroxydaidzein	metabolite	NIH 3T3 cells Incubation In vitro,	γ	N/A	N/A	N/A	117.6% 24 hours	↑PPAR γ protein transactivation	[96]

			unspecified							
Trifolium pretense	3-hydroxygenistein	metabolite	NIH 3T3 cells Incubation In vitro, unspecified	γ	N/A	N/A	N/A	137.4% 24 hours	↑PPAR γ protein transactivation	[96]
Trifolium pretense	6-hydroxygenistein	metabolite	NIH 3T3 cells Incubation In vitro, unspecified	γ	N/A	N/A	N/A	48.6 µM EC50 24 hours	↑PPAR γ protein transactivation	[96]
Trifolium pretense	3-hydroxygenistein	metabolite	NIH 3T3 cells Incubation In vitro, unspecified	γ	N/A	N/A	N/A	300% 24 hours	↑PPAR γ protein transactivation	[96]
Trifolium pretense	equol	metabolite	NIH 3T3 cells Incubation In vitro, unspecified	γ	N/A	N/A	N/A	93.5 µM EC50 24 hours	↑PPAR γ protein transactivation	[96]
Trifolium pretense	dihydrogenistein	metabolite	NIH 3T3 cells Incubation In vitro, unspecified	γ	N/A	N/A	N/A	78.4 µM EC 50 24 hours	↑PPAR γ protein transactivation	[96]
Trifolium pretense flower			Polar screen	γ	N/A	N/A	N/A	7.5 µg/mL	↑PPAR γ protein binding	[96]
Trifolium pretense flower			NIH 3T3 cells Incubation In vitro, unspecified	γ	N/A	N/A	N/A	23.4 µg/mL EC50 24 hours	↑PPAR γ protein transactivation	[96]
Trifolium pretense leaf			Polar screen	γ	N/A	N/A	N/A	12.9 µg/mL	↑PPAR γ protein Binding	[96]
Trifolium pretense leaf			NIH 3T3 cells Incubation In vitro, unspecified	γ	N/A	N/A	N/A	28.9 µg/ml EC50 24 hours	↑PPAR γ protein transactivation	[96]
*Withania somnifera**	Withaferin A	Lactone	3T3-L1 cells Incubation In vitro, Murine	γ	0.1,0.5,1.0 µM 6 days	N/A	N/A	N/A	↓PPAR γ protein	[97]
Zizyphus jujube	Chloroform fraction		3T3-L1 cells Incubation In vitro, Murine	γ	37.5 and 50 mcg/mL 8 days	N/A	N/A	N/A	↓PPARγ protein	[98]