SUPPLEMENTARY MATERIAL

A review on biological sources, chemistry and pharmacological activities of pinostrobin

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Abstract

Pinostrobin, a dietary bioflavanoid discovered more than 6 decades ago in the heart-wood of pine (*Pinus strobus*) and has depicted many pharmacological activities including anti-viral, anti-oxidant, anti-leukemic, anti-inflammatory and anti-aromatase activities. It is an inhibitor of sodium channel and Ca^{2+} signaling pathways and also inhibits intestinal smooth muscle contractions. In spite of the fact that pinostrobin has an application as functional foods, till-to-date no comprehensive review on pinostrobin has been carried out. Hence, the present review deals with the biological sources, chemistry and pharmacological activities of pinostrobin.

Keywords: Pinostrobin; Flavanones; Anti-inflammatory; Anti-cancer; Anti-viral; Functional foods

Supplementary table 1: Biological sources of Pinostrobin

S. No.	Biological Source	Extraction methodology	Parts used (yield on dry basis)	References
1.	<i>Cajanus cajan</i> (L.) Millsp (Fabaceae)	Ethanol (80%) (Closed microwave assisted extraction)	Leaves (0.35% w/w)	Chan et al., 2011
		Ethanol (95%) (Maceration)	Leaves (0.003% w/w)	Kong et al., 2010a
		CO ₂ and aqueous ethanol (Supercritical fluid extraction)	Leaves (0.273% w/w)	Kong et al., 2009; de Melo et al., 2014
		Ethanol (80%) (Negative-pressure cavitation extraction)	Leaves (0.054% w/w)	Kong et al., 2011
		Aqueous ethanol (Microwave assisted extraction)	Leaves (0.37% w/w)	Kong et al., 2010b
		Boiling ethanol (Maceration)	Leaves (0.005% w/w)	Nicholson et al., 2010
		Ethanol and water (80:20) (Maceration)	Leaves (0.008% w/w)	Duker-Eshun et al., 2004
		Ethanol (70%) (Ultrasonication)	Leaves (0.05-0.3% w/w)	Wei et al., 2013
		Ethanol (80%) (Percolation)	Leaves (0.36% w/w)	Wu et al., 2009
		Dichloromethane (Maceration)	Rhizome/Root (NA)	Fahey & Stephenson 2002
2.	<i>Boesenbergia pandurata</i> (Roxb.) (Zingiberaceae)	Methanol (Maceration)	Rhizomes (0.071% w/w)	Atun et al., 2013
		<i>n</i> -hexane (Maceration)	Rhizomes (0.099% w/w)	Charoensin et al., 2010
		Methanol (Maceration)	Rhizomes (0.081% w/w)	Trakoontivakorn et al., 2001
		Chloroform (Maceration)	Fresh yellow rhizome (NA)	Panthong et al., 1994
		Hexanes (Maceration)	Dried rhizomes (NA)	Tanjung et al., 2013
		Chloroform (Percolation)	Red rhizomes (1.302% w/w)	Tuchinda et al., 2002
		Chloroform (Maceration)	Rhizomes (0.007% w/w)	Jaipetch et al., 1982
		Methanol (Maceration)	Rhizomes (NA)	Abdelwahab et al., 2011
		Methanol (Maceration)	Rhizomes (0.02% w/w)	Feroz et al., 2013
		Hexane (Maceration)	Rhizomes (NA)	Pripdeevech et al., 2012
3.	<i>Kaempferia parviflora</i> (Wall. ex Baker) (Zingiberaceae)			
4.	<i>Boesenbergia longiflora</i> (Wall.)	Ethanol (Maceration)	Rhizomes (0.00008% w/w)	Sudsai et al., 2014

	(Zingiberaceae)			
5.	<i>Isodon oresbius</i> (W. W. Smith) (Labiatae)	Boiling Ethanol (95%) (Infusion)	Whole plant (0.090% w/w)	Hao et al., 1996
6.	<i>Muntingia calabura</i> (L.) (Muntingiaceae)	Methanol (Maceration) Methanol (Maceration)	Leaves (NA) Leaves (0.002% w/w)	Zakaria et al., 2014 Su et al., 2003
7.	<i>Lychnophora markgravii</i> (G.M. Barroso) (Asteraceae)	Dichloromethane (Maceration)	Aerial parts (0.087% w/w)	Sartori et al., 2002
8.	<i>Lychnophora reticulata</i> (Gardn.) (Asteraceae)	Acetonitrile and water (9:1) (Maceration)	Glandular trichomes of leaves (NA)	Alves et al., 2008
9.	<i>Lychnophora staavioides</i> (Mart.) (Asteraceae)	Methanol (Maceration)	Leaves (NA)	Takeara et al., 2003
10.	<i>Lychnophora ericoides</i> (Mart.) (Asteraceae)	Methanol (Maceration)	Leaves (0.009% w/w)	Gobbo-Neto, dos Santos, et al., 2008
11.	<i>Dysphania graveolens</i> (Willd.) (Chenopodiaceae)	Methanol and water (80:20) (Maceration) Water (Infusion) Methanol (Maceration) Chloroform (Maceration)	Glandular trichomes (NA) Aerial parts (0.016% w/w) Aerial parts (0.0006% w/w) Aerial parts (0.100% w/w)	Gobbo-Neto, Gates, et al., 2008 Álvarez-Ospina et al., 2013 Calzada et al., 2003 Mata et al., 1987
12.	From hive of <i>Apis mellifera</i> (L.) (Apidae)	Methanol (Sonication)	Thai propolis (0.035% w/w)	Athikomkulchai et al., 2013
13.	<i>Sarcandra hainanensis</i> (Pei) (Chloranthaceae)	Ethanol (Percolation)	Whole plant (0.00004% w/w)	Cao et al., 2009
14.	<i>Onychium auratum</i> (Kaulf.) (Cryptogrammataceae)	Light petroleum (Percolation)	Whole plant (NA)	Ramakrishnan et al., 1974

15.	<i>Onychium siliculosum</i> (Desv.) (Cryptogrammataceae)	Acetone (Maceration)	Fronds exudate (NA)	Wollenweber 1982
		Ethanol (Maceration)	Whole herb (0.092% w/w)	Wu et al., 1981
16.	<i>Pyracantha coccinea</i> (M.Roem.) (Rosaceae)	Chloroform and Methanol (9:1) (Percolation)	Dried roots (0.003% w/w)	Billia et al., 1993
17.	<i>Ribes viscosissimum</i> (Pursh) (Grossulariaceae)	Dichloromethane (Maceration)	Viscid leaves (NA)	Bohm 1993
18.	<i>Piper aduncum</i> (L.) (Piperaceae)	Methanol (Maceration)	Dried milled fruits (1.54% w/w)	Burke & Nair 1986
19.	<i>Piper hispidum</i> (Sw.) (Piperaceae)	Methanol (Maceration)	Dried milled fruits (1.54% w/w)	Burke & Nair 1986
20.	<i>Piper hostmannianum</i> (Miq.) (Piperaceae)	Ethyl acetate (Maceration)	Leaves (NA)	Portet et al., 2008
21.	<i>Piper methysticum</i> (G. Frost.) (Piperaceae)	Water (Maceration)	Roots (0.007% w/w)	Wu et al., 2002
22.	<i>Piper ecuadorens</i> e (Sodi	Methanol (Dynamic maceration)	Dried leaves (0.013% w/w)	Ramirez et al., 2013
23.	<i>Populus trichocarpa</i> (Torr. & Gray) (Salicaceae)	Diethylether (Maceration)	Bud exudates (NA)	English et al., 1991
24.	<i>Populus deltoides</i> (Marsh.) (Salicaceae)	Ethylacetate (Maceration)	Bud exudates (NA)	English et al., 1992
25.	<i>Populus nigra</i> (L.) (Salicaceae)	Dimethylether (Maceration)	Buds (NA)	Isidorov et al., 2014
26.	<i>Populus szechuanica</i> (S.)	Dimethylether (Maceration)	Buds (NA)	Isidorov et al., 2014

	(Salicaceae)			
27.	<i>Populus balsamifera</i> (L.) (Salicaceae)	Ethyl acetate (Maceration)	Bud exudate (NA)	Greenaway & Whatley 1990
28.	<i>Populus angustifolia</i> (J.) (Salicaceae)	Diethylether (Maceration)	Bud exudate (NA)	Greenaway et al., 1991
29.	<i>Pinus krempfii</i> (Lecomte) (Pinaceae)	Ether (Maceration)	Heartwood (NA)	Erdtman et al., 1966
30.	<i>Pinus morrisonicola</i> (Hay.) (Pinaceae)	Acetone (Maceration)	Heartwood (0.002% w/w)	Fang et al., 1987
31.	<i>Pinus armandii</i> (Fr.) (Pinaceae)	Acetone (Maceration)	Heartwood (0.0003% w/w)	Fang et al., 1988
32.	<i>Pinus clausa</i> (Vasey) (Pinaceae)	Ether (Maceration)	Heartwood (0.023% w/w)	Lindstedt 1950
33.	<i>Carya tonkinensis</i> (Lecomte) (Juglandaceae)	Chloroform (Maceration)	Leaves (0.1% w/w)	Cuong et al., 1996
34.	<i>Alnus viridis</i> (Chaix) (Betulaceae)	Acetone (Maceration)	Winter buds and catkins (male flowers) (NA)	Favre-Bonvin et al., 1978
35.	<i>Pyracantha coccinea</i> (M.J. Roemer) (Rosaceae)	Ethanol (Percolation)	Roots (NA)	Fico et al., 2000
36.	<i>Prunus cerasus</i> (L.) (Rosaceae)	Acetone and water (4:1) (Maceration)	Bark (NA)	Geibel & Feucht 1991
37.	<i>Prunus avium</i> (L.) (Rosaceae)	Acetone and water (7:3) (Maceration)	Heartwood (0.400% w/w)	Vinciguerra et al., 2003
38.	<i>Renealmia alpinia</i> (Mass.)	Dichloromethane (Maceration)	Dried leaves (0.321% w/w)	Gómez-Betancur et al., 2014

	(Zingiberaceae)			
39.	<i>Renealmnia nicolaioides</i> (Loes.) (Zingiberaceae)	Methanol (Maceration)	Roots (0.374% w/w)	Gu et al., 2002
40.	<i>Salavia texana</i> (Torr.) (Labiatae)	Cold Methanol (Maceration)	Roots (0.0008% w/w)	González et al., 1989
41.	<i>Pityrogramma tartarea</i> (Cav.) (Polypodiaceae)	Acetone (Maceration)	Frond exudates (NA)	Iinuma et al., 1994
42.	<i>Miliusa balansae</i> (Fin. & Gagn.) (Annonaceae)	Methanol and water (95:5) (Maceration)	Dried leaves and branches (0.010% w/w)	Kamperdick et al., 2002
43.	<i>Miliusa sinensis</i> (Fin. & Gagn.) (Annonaceae)	Methanol (95%) (Maceration)	Dried leaves and branches (0.0066% w/w)	Thuy et al., 2011
44.	<i>Polygonum limbatum</i> (Meisn.) (Polygonaceae)	Metahnol (Maceration)	Aerial parts of plant (NA)	Kuete et al., 2013
45.	<i>Polygonum ferrugineum</i> (Wedd.) (Polygonaceae)	Methanol (Maceration)	Dried leaves (0.010% w/w)	López et al., 2006
46.	<i>Dalbergia odorifera</i> (T. Chen) (Leguminosae)	Metahnol (Maceration)	Heartwood (NA)	Lee et al., 2013
47.	<i>Litsea fruticosa</i> (Hemsl.) (Lauraceae)	Ethanol (Maceration)	Dried leaves (0.0017% w/w)	Liu et al., 2013
48.	<i>Corymbia torelliana</i> (F.Muell.) (Myrtaceae)	Metahnol (Maceration)	Fruit resins of capsules (NA)	Massaro et al., 2014
49.	<i>Gymnema montanum</i> (H.) (Asclepiadaceae)	Ethanol (95%) (Percolation)	Fresh leaves (NA)	Ramkumar et al., 2009

50.	<i>Uvaria chamae</i> (P. Beauv.) (Annonaceae)	Ethanol (95%) (Percolation)	Root bark (0.0019% w/w)	Lasswell et al., 1977
51.	<i>Lindera umbellata</i> (Thunb.) (Lauraceae)	Hot Methanol (Maceration)	Fresh bark (0.170% w/w)	Shimomura et al., 1988
		Methanol (Maceration)	Fresh leaves (0.009% w/w)	Ichino et al., 1988
52.	<i>Myrica pensylvanica</i> (Loisel) (Myricaceae)	Acetone (Maceration)	Leaves and young twigs (NA)	Wollenweber et al., 1985
53.	<i>Pinus strobus</i> (L.) (Pinaceae)	Hexane (Maceration)	Wood (0.0116% w/w)	Carvalho et al., 1996

NA: Not available

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