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REVIEW ARTICLE

RECORDS OF PHARMACEUTICAL AND BIOMEDICAL SCIENCES

Chemistry of Bamboo *Phyllostachys* Genus: A Mini Review

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Abstract

For several drugs in use, nature is still a valuable source. Natural product screening is among the most reliable ways to produce new products. Bamboo plant is widespread all over the world. It has approximately 75 genera and 1250 species. Phytochemical investigation of Bamboo *Phyllostachys* genus has revealed the existence of a broad range of bioactive compounds, which include flavonoids, phenolic glycosides, phenolic acids, glycosides and sterols. This review study showed that secondary metabolites identified in Bamboo *Phyllostachys* genus were including flavonoids, lignans, phenolic glycosides, phenolic acids and sterols.

Key words: *Phyllostachys*, Bamboo, Secondary metabolites

1. Introduction:

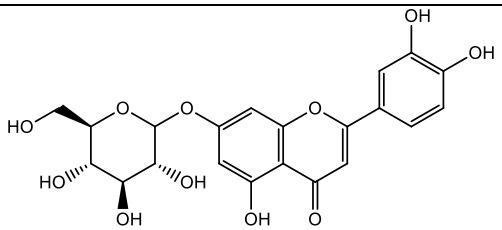
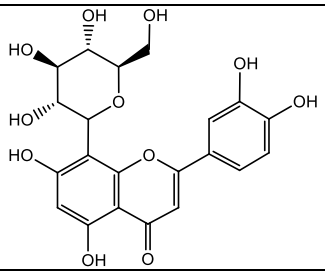
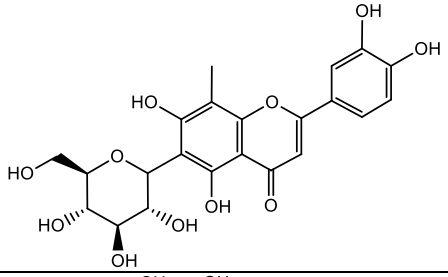
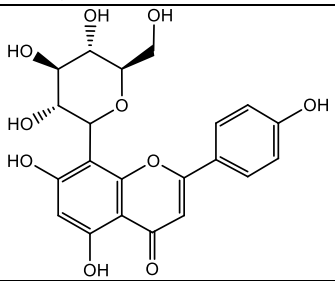
Nature is still a valuable source for many used pharmaceutical products (**Grabley and Sattler, 2003**). In the proteomics, present drug discovery programs, natural products or compounds derived from natural products account for more than 40% of the new registered drugs (**Cragg et al., 2012**). A broad variety of chemical structures produced by natural products are still unapproachable by highly formulated synthetic standards. Natural products have also introduced unique therapeutical modalities that have helped to develop novel biochemical approaches. **(Grabley and Sattler, 2003)**.

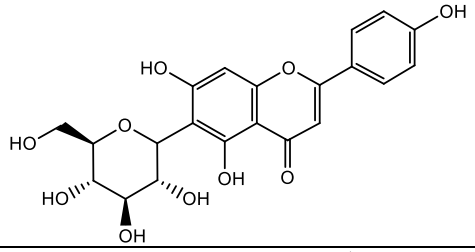
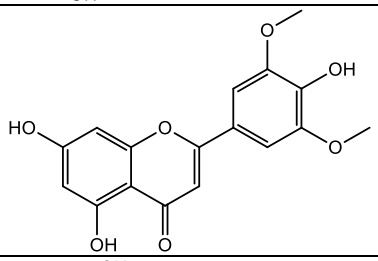
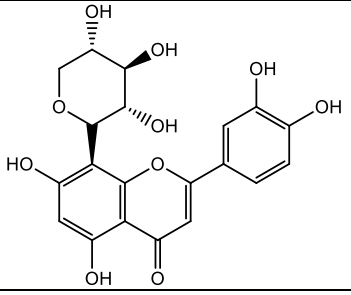
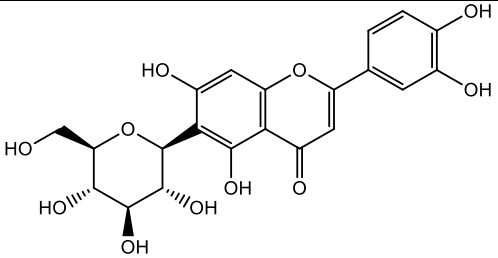
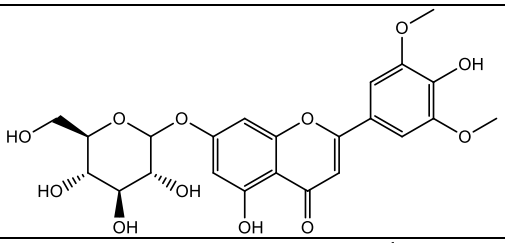
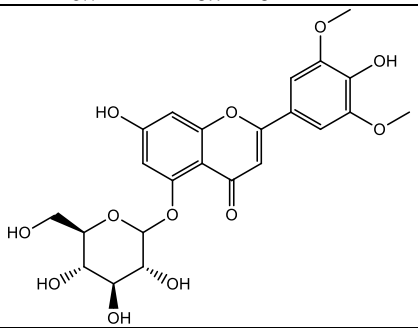
Bamboo plant is widespread all over the world. It has approximately 75 genera and 1250 species (**Yuming et al., 2014**). Since ancient times, bamboo has been a considerable source of food and medicine in China and South East Asia. Almost all parts of the bamboo plant such as rhizome, culm and bark shaving, shoots, leaves, roots and seeds are having clinical applications. Recently, bamboo gained attention around the world because of its nutritive and therapeutic values and the important role it plays in the food, pharmaceutical and cosmeceutical industry (**Nirmala, et al., 2018**). Bamboo leaves and shoots

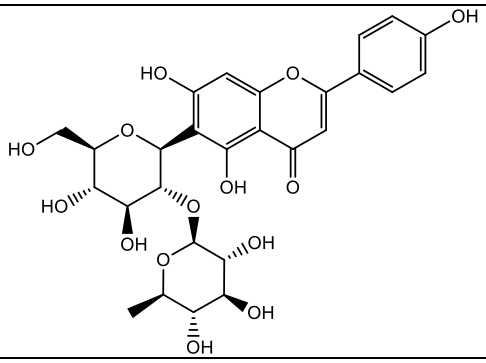
have tremendous therapeutic potential and can provide health care in a safe and eco-friendly way. (**Nirmala & Bisht, 2017; Tiwari, 1988**). Bamboo plant is commonly used in folk medicine for their antipyretic, anti-inflammatory, and diuretic effect (**Chongtham *et al.*, 2011**). The therapeutic use of bamboo leaves for treating arteriosclerosis, hypertension, cardiovascular disease, and cancer have been also reported (**Park *et al.*, 2007**). Additionally, antioxidant and angiotensin-converting enzyme inhibition activity were also proven (**Park *et al.*, 2010; Zhang *et al.*, 2008**).Phytochemical investigation of Bamboo *Phyllostachys* genus has revealed the existence of a broad range of bioactive compounds, such as flavonoids, phenolic glycosides, phenolic acids, glycosides (**Xu *et al.*, 2014**) and sterols (**Jiao *et al.*, 2007**).

2. Chemical constituents reported from some species of genus *Phyllostachys*:

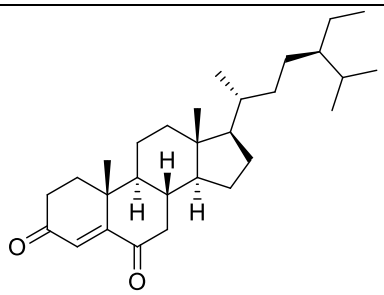
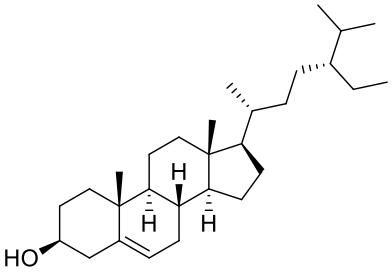
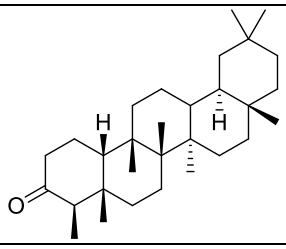
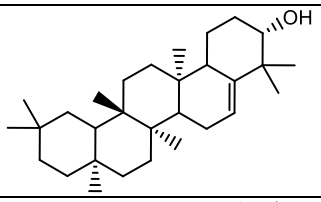
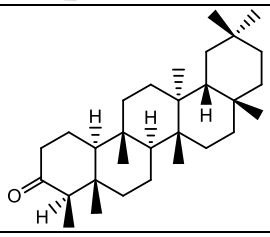
2.1: Flavonoids:

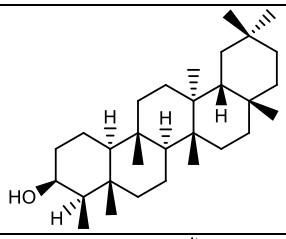
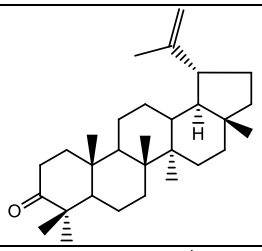
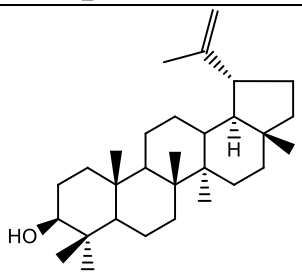
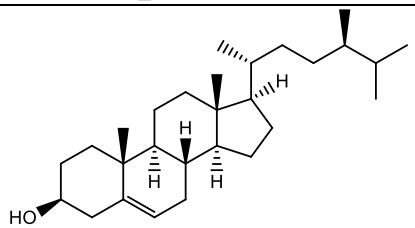
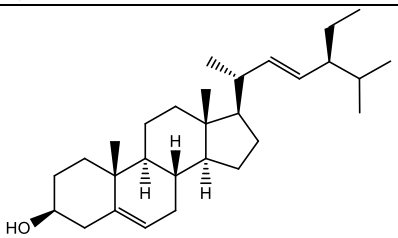
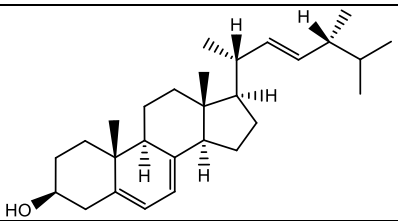
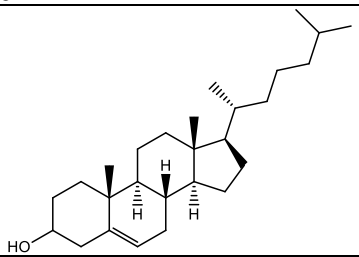
Species	Compound Name	Compound Structure	Reference
Phyllostachys nigra var. henonis *Phyllostachys prominens*	luteolin-7-*O*-glucoside		**(Hu *et al.*, 2000**) (**Xu *et al.*, 2016**)
Phyllostachys nigra var. henonis	Orientin		(**Zhang *et al.*, 2008**)
Phyllostachys nigra var. henonis	homoorientin		(**Zhang *et al.*, 2008**)
Phyllostachys nigra var. henonis	vitexin		(**Zhang *et al.*, 2008**)

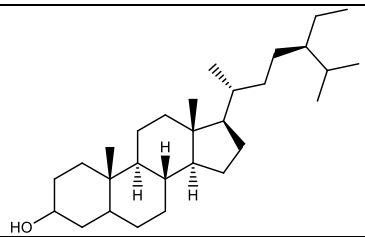
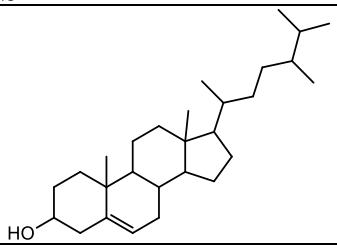
Phyllostachys nigra var. henonis	isovitexin		(**Zhang *et al.*, 2008**)
Phyllostachys nigra	tricin		(**Shang *et al.*, 2014**)
Phyllostachys prominens	luteolin-8-C-*α*-L-arabinose		(**Xu *et al.*, 2016**)
Phyllostachys prominens	isoorientin		(**Xu *et al.*, 2016**)
Phyllostachys prominens	tricin-7-*O*-*β*-D-glucoside		(**Xu *et al.*, 2016**)
Phyllostachys prominens	tricin-5-*O*-*β*-D-glucoside		(**Xu *et al.*, 2016**)

Phyllostachys prominens	isovitexin-2"-xylopyranoside		(**Xu *et al*., 2016**)

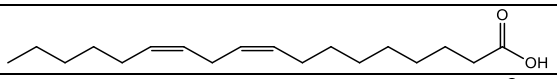
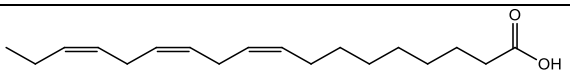
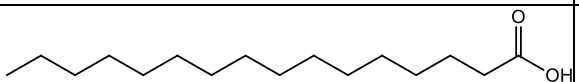
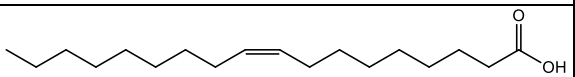
2.2: Sterols and Terpenoids:

Species	Compound Name	Compound Structure	Reference
Phyllostachys edulls	stigmast-4-ene-3,6-dione		(**Suga *et al*., 2003**)
Phyllostachys edulls *Phyllostachys pubescens*	*β*-sitosterol		(**Suga *et al*., 2003**) (**Lu *et al*., 2010; Tanaka *et al*., 2013**)
Phyllostachys edulls	friedelin		(**Suga *et al*., 2003**)
Phyllostachys edulls	glutinol		(**Suga *et al*., 2003**)
Phyllostachys nigra var. henonis	friedelane-3-one		(**Jiao *et al*., 2007**)

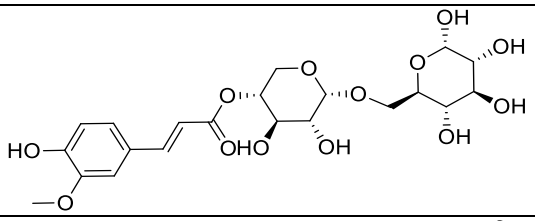
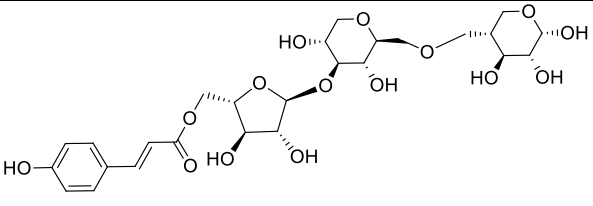
Phyllostachys nigra var. henonis	friedelane-3-ol		(**Jiao *et al*., 2007**)
Phyllostachys nigra var. henonis	lup-20(29)-en-3-one		(**Jiao *et al*., 2007**)
Phyllostachys nigra var. henonis	lup-20(29)-en-3-ol		(**Jiao *et al*., 2007**)
Phyllostachys pubescens	campesterol		(**Lu *et al*., 2010**)
Phyllostachys pubescens	stigmasterol		(**Lu *et al*., 2010**) (**Tanaka *et al*., 2013**)
Phyllostachys pubescens	ergosterol		(**Lu *et al*., 2010**)
Phyllostachys pubescens	cholesterol		(**Lu *et al*., 2010**)

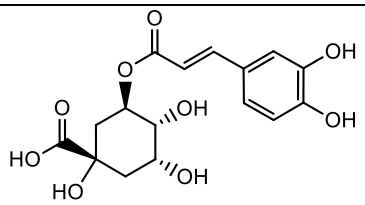
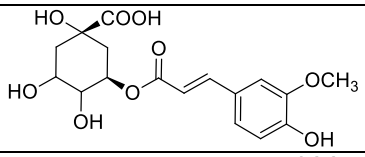
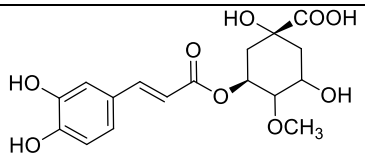
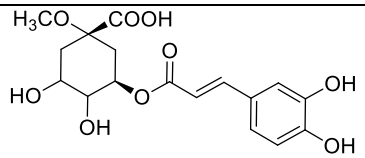
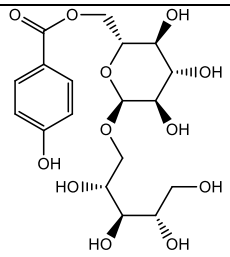
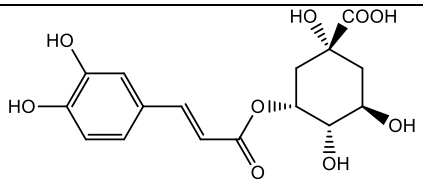
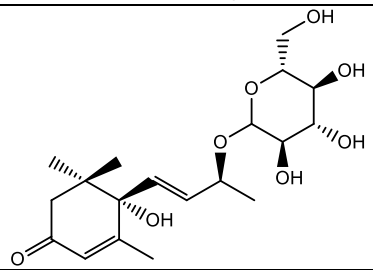
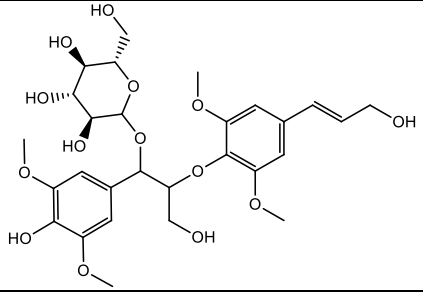
Phyllostachys pubescens	stigmastanol		(**Lu *et al*., 2010**)
Phyllostachys pubescens	Dihydrobrassicasterol		(**Tanaka *et al*., 2013**)

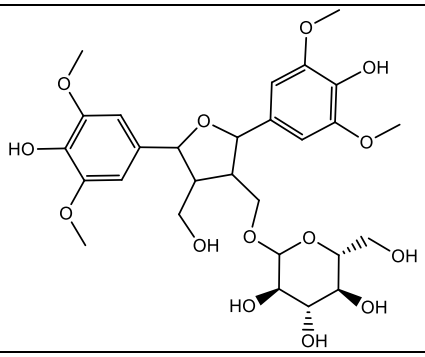
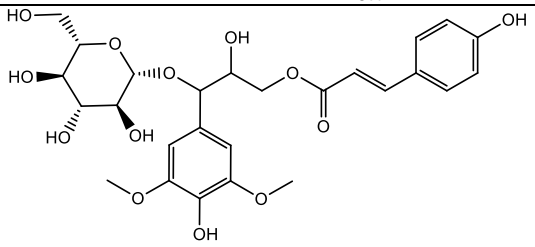
2.3: Fatty Acids:

Species	Compound Name	Compound Structure	Reference
Phyllostachys pubescens	linoleic acid		(**Lu *et al*., 2010**)
Phyllostachys pubescens	linolenic acid		(**Lu *et al*., 2010**)
Phyllostachys pubescens	palmitic acid		(**Lu *et al*., 2010**)
Phyllostachys pubescens	oleinic acid		(**Lu *et al*., 2010**)

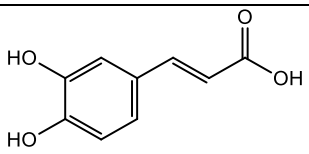
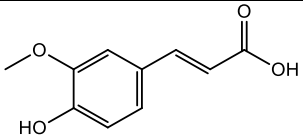
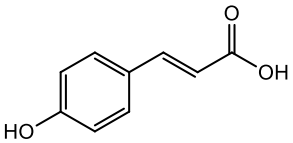
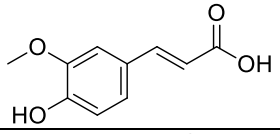
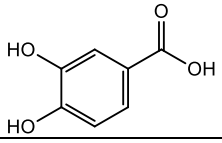
2.4: Phenolic Glycosides:

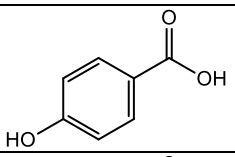
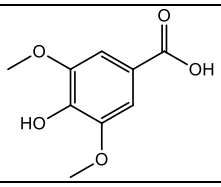
Species	Compound Name	Compound Structure	Reference
Phyllostachys edulls	*O*-(4-*O*-*trans*-feruloyl-*α*-D-xylopyranosyl)-(1→6)-D-glucopyranose		(**Ishii *et al*., 1990**)
Phyllostachys edulls	*O*-[5-*O*-(*trans*-*p*-coumaroyl)-*α*-L-arabinofuranosyl]-(1→3)-*O*-*β*-D-xylopyranosyl-(1→4)-D-xylopyranose		(**Ishii *et al*., 1990**)

Phyllostachys nigra var. henonis *Phyllostachys edulls* *Phyllostachy pubescence*	chlorogenic acid		**(Hu *et al*., 2000)** **(Kweon *et al*., 2001)** **(Park *et al*., 2010)**
Phyllostachys edulls	3-*O*-(3'-methylcaffeoyl) quinic acid		**(Kweon *et al*., 2001)**
Phyllostachys edulls	5-*O*-caffeoyl-4-methylquinic acid		**(Kweon *et al*., 2001)**
Phyllostachys edulls	3-*O*-caffeoyl-1-methylquinic acid		**(Kweon *et al*., 2001)**
Phyllostachys prominens	xylitol 1-*O*-(6'-*O*-*p*-hydroxylbenzoyl)-glucopyranoside		**(Xu *et al*., 2016)**
Phyllostachys prominens	5-*O*-caffeoylquinic acid		**(Xu *et al*., 2016)**
Phyllostachys prominens	(6s,9s)-drummondol-9-*O*-*β*-D-glucopyranoside		**(Xu *et al*., 2016)**
Phyllostachys prominens	3,5,3',5'-tetramethoxy-4-hydroxyl-(8-*O*-cinnamyl alcohol)-7-*O*-glucoside		**(Xu *et al*., 2016)**

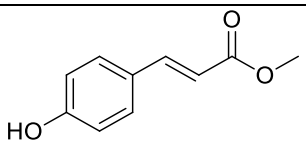
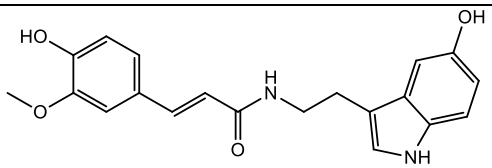
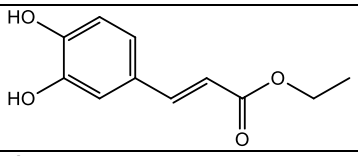
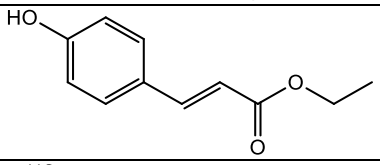
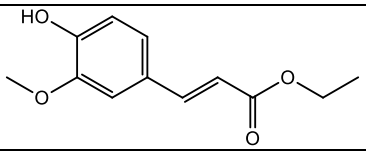
Phyllostachys prominens	4, 4', 9'-trihydroxyl-3, 5, 3', 5'-tetramethoxy-7, 7'-monoepoxylignan-9-*O*-glucoside		(**Xu *et al*., 2016**)
Phyllostachys prominens	3,5-dimethoxy-4,4'-dihydroxyl-9-*O*-benzylacrylicester-phenylpropano-7-*O*-glucopyranoside		(**Xu *et al*., 2016**)

2.5: Phenolic Acids:

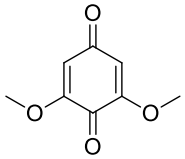
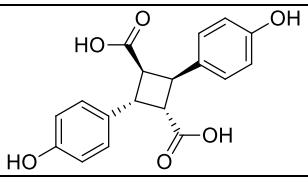
Species	Compound Name	Compound Structure	Reference
Phyllostachys nigra var. henonis *Phyllostachys edulls* *Phyllostachy pubescence*	Caffeic acid		(**Hu *et al*., 2000**) (**Kweon *et al*., 2001**) (**Park *et al*., 2010**)
Phyllostachys edulls *Phyllostachy pubescence*	Ferulic acid		(**Kweon *et al*., 2001; Suga *et al*., 2003**) (**Park *et al*., 2010**)
Phyllostachys edulls *Phyllostachy pubescence* *Phyllostachys nigra*	*p*-coumaric acid		(**Suga *et al*., 2003**) (**Park *et al*., 2010**) (**Shang *et al*., 2014**)
Phyllostachys edulls	3-(4-hydroxy-3-methoxyphenyl)-2-propenoic acid		(**Suga *et al*., 2003**)
Phyllostachy pubescence	protocatechuic acid		(**Park *et al*., 2010**)

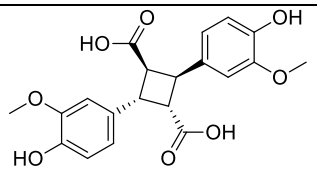
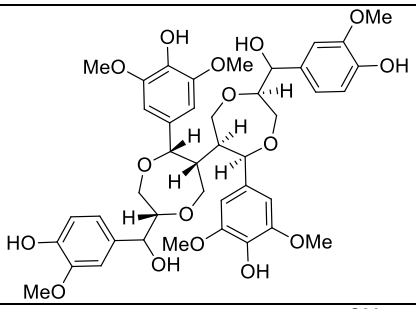
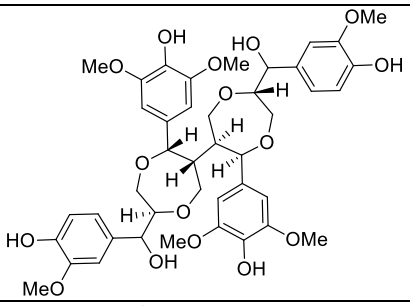
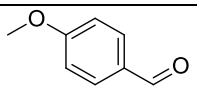
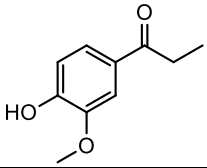
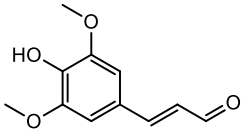
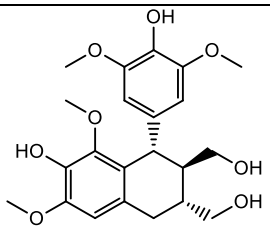
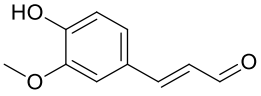
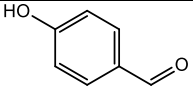
Phyllostachy pubescence	*p*-hydroxybenzoic acid		(**Park *et al*., 2010**)
Phyllostachy pubescence	syringic acid		(**Park *et al*., 2010**)

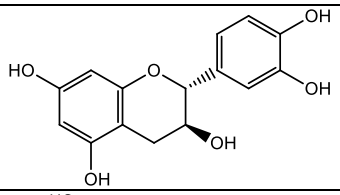
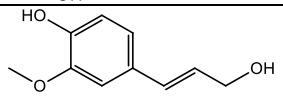
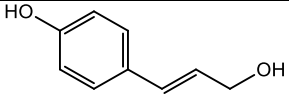
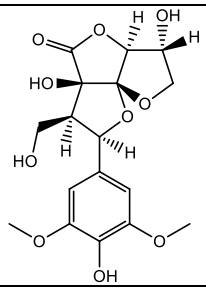
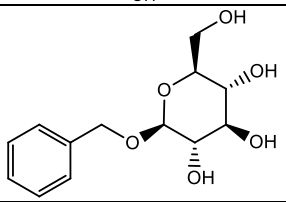
2.6: Phenolic Acids derivatives:

Species	Compound Name	Compound Structure	Reference
Phyllostachys edulls	*p*-coumaric acid methyl ester		(**Suga *et al*., 2003**)
Phyllostachys nigra	*n*-feruloyl serotonin		(**Shang *et al*., 2014**)
Phyllostachys nigra	caffeic acid ethyl ether		(**Shang *et al*., 2014**)
Phyllostachys nigra	*p*-coumaric acid ethyl ether		(**Shang *et al*., 2014**)
Phyllostachys nigra	ferulic acid ethyl ether		(**Shang *et al*., 2014**)

2.7: Miscellaneous compounds:

Species	Compound Name	Compound Structure	Reference
Phyllostachys heterocycla	2,6-dimethoxy-*p*-benzoquinone		(**Nishina *et al*., 1991**)
Phyllostachys edulls	2*α*, 4*β*-*bis*(4-hydroxyphenyl)cyclobutane-1*α*,3*β*-dicarboxylic acid		(**Tachibana *et al*., 1992**)

Phyllostachys edulls	2*α*, 4*β*-*bis*(4-hydroxy-3-methoxyphenyl)cyclobutane-1*α*,3*β*-dicarboxylic acid		(**Tachibana *et al*., 1992**)
Phyllostachys edulls	phyllostadimers A		(**Suga *et al*., 2003**)
Phyllostachys edulls	phyllostadimers B		(**Suga *et al*., 2003**)
Phyllostachys edulls	4-methoxybenzaldehyde		(**Suga *et al*., 2003**)
Phyllostachys edulls	4-hydroxy-3-methoxypropiophenone		(**Suga *et al*., 2003**)
Phyllostachys edulls	sinapaldehyde		(**Suga *et al*., 2003**)
Phyllostachys edulls	lyoniresinol		(**Suga *et al*., 2003**)
Phyllostachys edulls	coniferaldehyde		(**Suga *et al*., 2003**)
Phyllostachys edulls	4-hydroxybenzaldehyde		(**Suga *et al*., 2003**)

Phyllostachy pubescence	catechin		(**Park *et al*., 2010**)
Phyllostachys nigra	*trans*-coniferyl alcohol		(**Shang *et al*., 2014**)
Phyllostachys nigra	*p*-coumaryl alcohol		(**Shang *et al*., 2014**)
Phyllostachys prominens	amarusine A		(**Xu *et al*., 2016**)
Phyllostachys prominens	benzyl-*O*-*β*-D-glucopyranoside		(**Xu *et al*., 2016**)

3. Conclusion:

Bamboo (*Phyllostachys)* genus showed existence of a broad range of bioactive compounds, which include flavonoids, sterols, fatty acids, phenolic glycosides, phenolic acids, phenolic acids derivatives along with many other Miscellaneous compounds. This review study covered the secondary metabolites reported in the *Phyllostachys* Bamboo genus.

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