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Review Article

An Update on Natural Occurrence and Biological Activity of Benzofurans

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Graphical Abstract

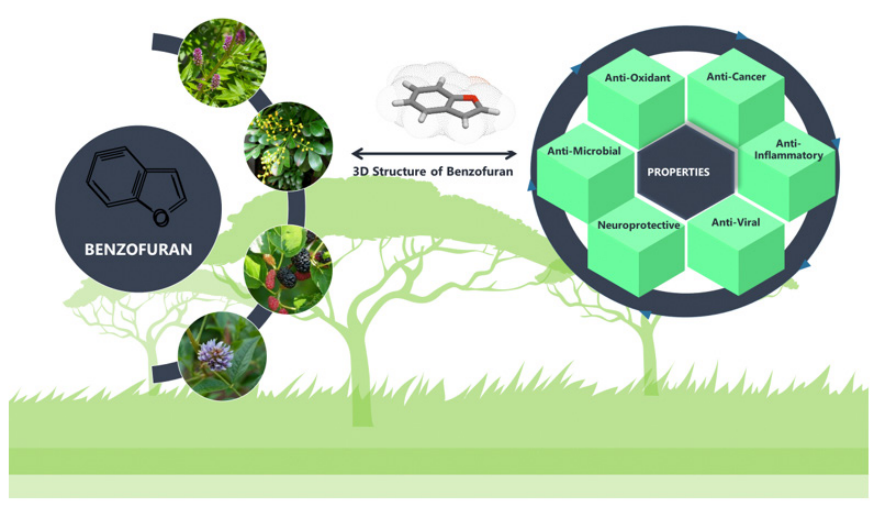


Figure a

Abstract

Benzofuran and its derivatives are the major group amongst the natural collection of biologically active heterocyclic compounds. Their wide range of pharmacological activities and imaginable applications in medicinal and pharmaceutical chemistry have attracted various research scholars, medicinal chemists and pharmacologists. This review emphasizes the progress and development of benzofuran derivatives in various biological activities with an update of current research findings during a decade.

Keywords: Benzofuran; Antioxidant; Antiviral; Antimicrobial; Anticancer

Introduction

Heterocyclic ring systems have emerged as powerful scaffolds for many biological evaluations. Heterocyclic compounds have significant role in medicinal and pharmacological chemistry, physiological and industrial world. In reference to pharmaceutical industry, over 60% of the top retailing drugs contain at least one heterocyclic motif as a part of overall topography of the compound. Benzofurans and its derivatives are important class of heterocyclic

compounds, which are known to possess various biological properties. Benzofuran derivatives are versatile biodynamic agents that can be used to design and develop potentially useful therapeutic agents [1]. There is a great importance of several derivatives of furans in flavors and fragrances also. For example, furaneol is responsible for odor in strawberries; rose flower has odor due to rosefuran [3-methyl-2-(3-methylbut-2-enyl)-furan]; coffee shows its characteristics due to furylmethanethiol (Figure 1). Various natural benzofurans derivatives are also found to act as cytotoxic, anti-oxidant, anti-inflammatory, anti-fungal, neuroprotective and analgesic activity, anti-viral, edible, anti-allergic etc. A wide range of benzofurans have been isolated from natural sources. Their occurrence is confined to botanical species, zoological species and fungi species like, *Aglaia perviridis*, *Eupatorium chinense*, *Tephrosia purpurea*, *Morus alba*, *Morus macroura*, *Liriope spicatavar*. *Prolifera, Eupatorium coelestinum, Ligularia veitchiana*, *Paeonia veitchii*, *Itea ilicifolia* etc. Since many years, isolated benzofurans and their derivatives have been used for various biological activities e.g., anti-oxidants, antitumor, anti-inflammatory, anti-malarial, antiviral, exert anti-angiogenic effects (avoids the growth of blood vessels) etc. Numerous botanical species containing benzofuran derivatives are being used for treatment of headache, dizziness, anti-cancer drugs, anti-malarial drugs, migraine, epilepsy, infantile convulsion, tetanus etc.

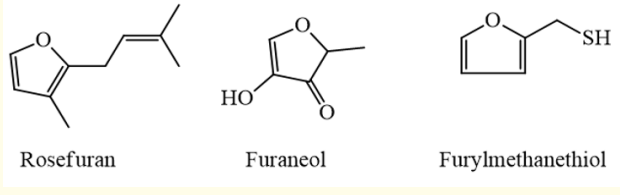
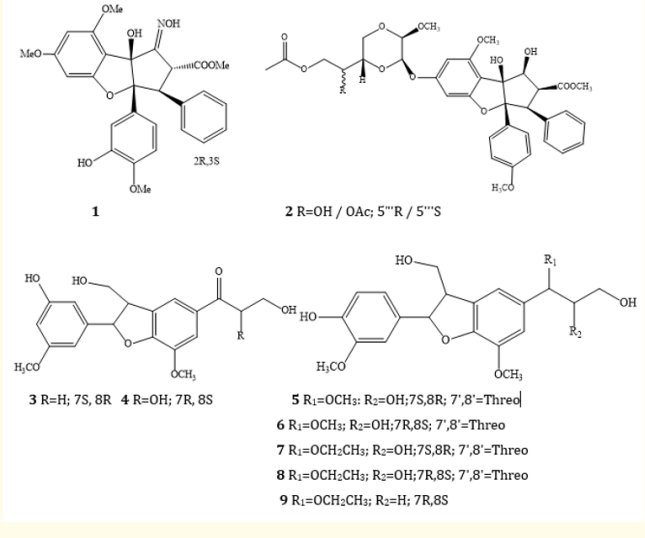


Figure 1

Anti-cancer activity

Benzofurans and its derivatives play an important role in treating cancerous cells, for example, benzofuran derivative, aglaodoratin (1), isolated from leaves of "*Aglaia odorata"* demonstrated the inhibition of HepG2 liver carcinoma cell proliferation *via* G2/M arrest and induced apoptotic cell death at a concentration of 25 µM [2]. Furthermore, aglapervirisin (2) isolated from leaves of '*Aglaia perviridis*' was also known to possess significant cytotoxicity against human tumors cell lines [3]. Another research also revealed the cytotoxic potential of benzofuran analogs (3-12) extracted from seeds of *Crataegus pinnatifida* against HT-1080 human cancer cell lines. (E)-3-((2S,3S)-2-(4-hydroxy-3-methoxyphenyl)-3-(hydroxymethyl)-7-methoxy-2,3-dihydrobenzo furan-5-yl) acryl aldehyde (12) displayed exceptional inhibitory activity (IC_{50} = 8.86 µM) as compared with positive control 5-fluorouracil (IC_{50} = 35.62 µM) [4]. Hang., *et al*. also studied the anticancer activity of 5α,8α-epoxy-4α,6β-dihydroxyamorphan-2-one (13) extracted from aerial parts of *Eupatorium coelestinum* which was found to strongly inhibit the activation of NF-κB in TNF-α-stimulated HeLa cells (IC_{50} of 12.4 µM) [5]. In a different study, two new benzofuran derivatives, 2-(4′-hydroxybenzyl)-5,6-methylenedioxy-benzofuran (14) and 2-(4′-hydroxybenzoyl)-5,6-methylenedioxybenzofuran (15), isolated from roots of "*Liriope spicatavar*. *Prolifera"* exhibited significant inhibitory activity against neutrophil respiratory burst with IC_{50} values 4.15 ± 0.07 and 5.96 ± 0.37 µM, respectively [6]. Another series of compound 2-(3′-hydroxy-5′-methoxyphenyl)-3-hydroxylmethyl-7-methoxy-2,3-dihydrobenzo furan-5-carboxylic acid (16) and 7-hydroxy-5,4′-dimethoxy-2-arylbenzofuran (17) which were isolated from the fruits of *Livistona chinensis* revealed potential anticancer activity against K562 and HL-60 human myeloid leukemia, CNE-1 human nasopharyngeal carcinoma cell lines and HepG2 human liver cancer with IC_{50} value ranging 5-150 µM [7]. 3-hydroxy-2-(3-methyl-2-butenyl)-1-(2-phenylethyl) benzofuran (18) isolated from twigs of "*Macaranga kurzii*" exhibited modest cytotoxicity against Hep G2 cell line with IC50 value of 30.14 µg/mL [8]. Compounds 19-27 extracted from leaves of *Morus notabilis* were also found to show inhibition against PTP1B phosphatase activity *in vitro* [9]. Furthermore, a new benzofuran derivative 1-[6-hydroxy-2-isopropenyl-1-benzofuran-5yl]-1-ethanone (28) isolated from *Petasites hybridus* roots showed moderate inhibitory activity on human breast cancer MCF-7 cells proliferation *in vitro* with IC_{50} value of 58 µmole/litre [10]. In another report, two novel chlorinated benzofurans, 3-hydroxy-1-(4,6,8-trichloro-1,9-dihydroxy-3,7-dimethoxydibenzo[b,d]furan-2-yl)propan-1-one (29) and 1-(4,6,8-trichloro-9-hydroxy-1,3,7-trimethoxydibenzo[b,d] furan-2-yl)butan-1-one (30) isolated from fruiting body of slime moulds of *Polysphondylium filamentosum* showed inhibitory activities on cell proliferation in mammalian cells and gene expression in *Drosophila melanogaster* [11]. 4,7,8-trimethoxy-2,3-methylenedioxydibenzofuran (31), 7-hydroxy-4,8-dimethoxy-2,3-methylene dioxydibenzofuran (32) isolated from aerial parts of *Ribes takare* showed mild α-glucosidase inhibitory activity [12]. (E)-3-(2-(benzo[d][1,3] dioxol-5-yl)-7-methoxybenzofuran-5-yl) acrylaldehyde (33), a known benzofuran derivative, which is isolated from stem bark of "*Duabanga grandiflora"* used as cytotoxic activities against cancer cell line Acute Lymphoblastic Leukemia (MOLT-3) with IC_{50} value of 18.1 µM [13]. Ganodone (34) extracted from the fruits of "*Ganoderma tsugae"* is used as a potential

source of new anti-cancer medicines [14]. A known dihydrobenzofuran, 4-((2S,3R)-3-(hydroxymethyl)-5-(3-hydroxypropyl)-7-methoxy-2,3-dihydrobenzofuran-2-yl)-2,6-dimethoxyphenol (35), extracted from *Selaginella moellendorffii* showed better inhibitory activity as compared with tirofiban against collagen induced aggregation of platelets [15]. In another report, compounds (E)-3-(2-(benzo[d][1,3]dioxol-5-yl)-7-methoxybenzofuran-5-yl)prop-2-en-1-ol (36) and (E)-methyl 3-(2-(benzo[d][1,3]dioxol-5-yl)-7-methoxybenzofuran-5-yl)acrylate (37), isolated from the methnolic extract of the African medicinal plant "*Zanthoxylum capens"* also showed strong anticancer activity in HCT116 colon carcinoma cells [16]. A novel compound, 2,3-dihydro-2-[4-(β-glucopyranosyl (1→2)-[β-glucopyranosyl(1→6)]-β-glucopyranosyloxy)-3-methoxyphenyl]-3-(hydroxymethyl)-7-methoxy-5-benzofuranpropanol (38) and a known compound (2R,3S,4S,5R,6S)-2-(hydroxymethyl)-6-(4-((2R,3S)-3-(hydroxymethyl)-5-((E)-3-hydroxyprop-1-en-1-yl)-7-methoxy-2,3-dihydrobenzofuran-2-yl)-2-methoxy phenoxy) tetrahydro-2H-pyran-3,4,5-triol (39) extracted from the plant of *Castanea henryi* acts as a key enzyme that is tyrosinase inhibitor [17]. Two compounds (40) and (41) isolated from the heartwood of *D.odorifera*. compound (40) showed positive results against myelogenous leukemia cell line K562, human hepatocellular carcinoma cell line BEL-7402 and human gastric carcinoma cell line SGC-7901. Compound (41) revealed the IC50 value of 33.5μM against BEL-7402 cell line for positive control paclitaxel [18]. A novel compound, 2,2-dimethyl-4-(3-methylbut-3-en-1-yn-1-yl)-2,3-dihydrobenzofuran-7-ol (42) extracted from *Pestalotiopsis fici* showed cytotoxic activity [19]. A known benzofuran, flavonolignan silybin (43) extracted from *Silybum marianum* showed anticancer properties [20].



1 **2** R=OH / OAc; 5'''R / 5'''S

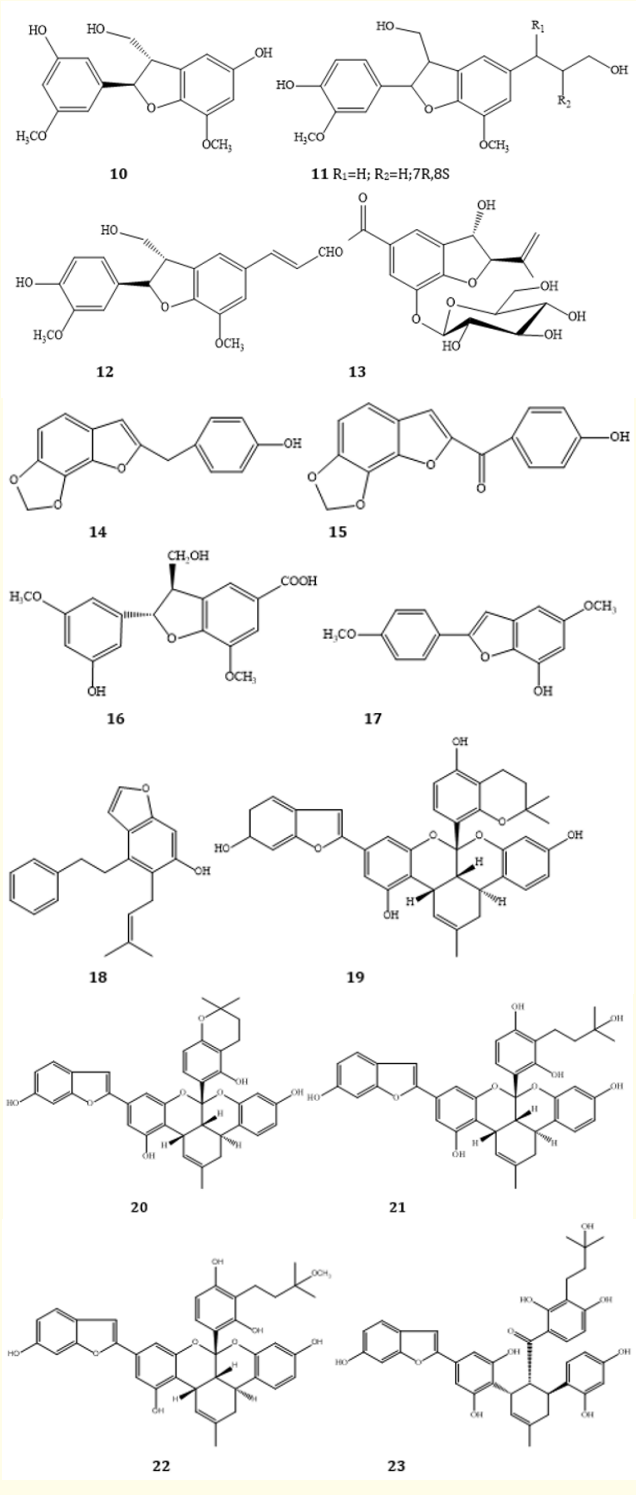
3 R=H; 7S, 8R **4** R=OH; 7R, 8S **5** R_1=OCH_3: R_2=OH;7S,8R; 7',8'=Threo

6 R_1=OCH_3; R_2=OH;7R,8S; 7',8'=Threo

7 R_1=OCH_2CH_3; R_2=OH;7S,8R; 7',8'=Threo

8 R_1=OCH_2CH_3; R_2=OH;7R,8S; 7',8'=Threo

9 R_1=OCH_2CH_3; R_2=H; 7R,8S



10 **11** R_1=H; R_2=H;7R,8S

12 **13**

14 **15**

16 **17**

18 **19**

20 **21**

22 **23**

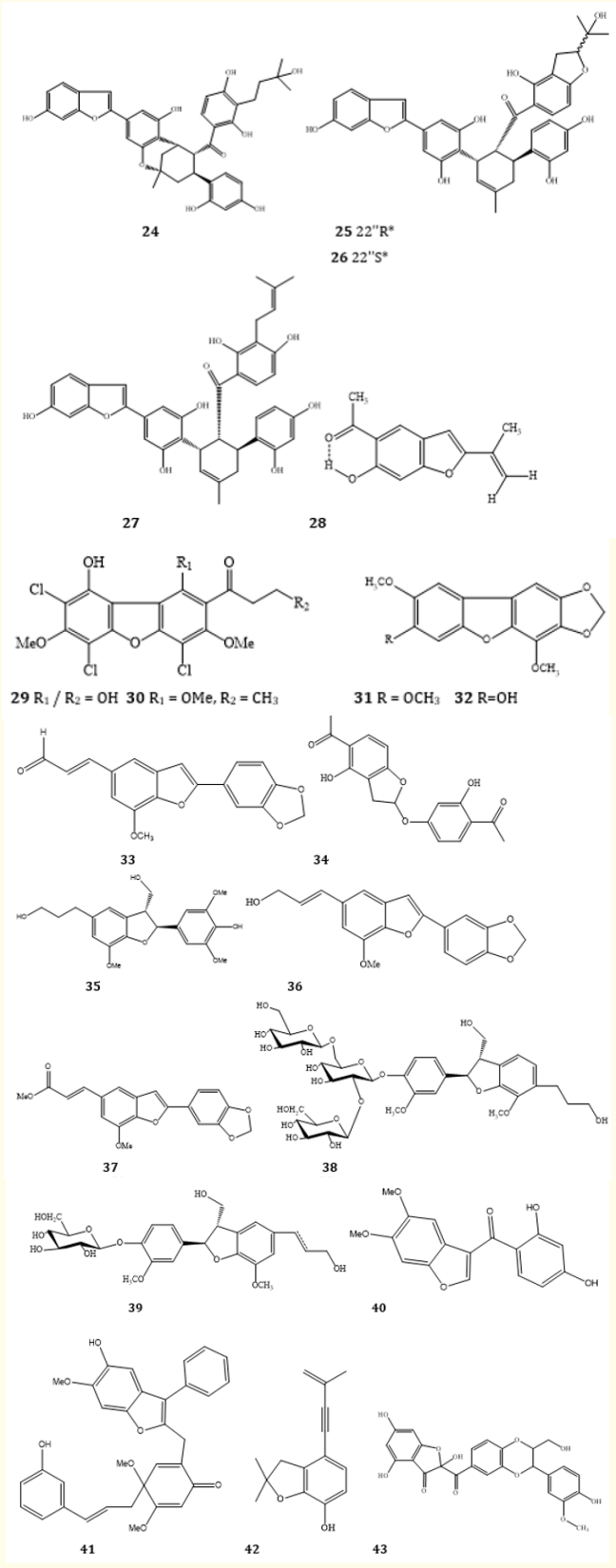


Figure 2

Anti-oxidant activity

Anti-oxidants act as defense system in our body. They protect us from heart disease, cancer, Alzheimer's, Parkinson's and cataract disease, etc. The compounds that can donate electrons and counteract free radicals have anti-oxidant properties. Anti-oxidant compounds can "donate" electrons to unstable free radicals so they don't have to snatch electrons from unsuspecting nearby cells. Anti-oxidants help in repairing of cells which are damaged by free radicals or we can say that they are taken as remedies to overcome the lethal action of oxygen free radicals. For example, a citation revealed significant antioxidant properties of compounds, 2-(2′-methoxy-4′-hydroxy)-aryl-3-methy-6-hydroxy-benzofuran (44) and (Z)-2-(3,4-dihydroxybenzylidene)-6-hydroxybenzofuran-3(2*H*)-one (45) extracted from *Glycyrrhiza yunnanensis* [21]. Two novel compounds, (*E*)-2-(3,4-dihydroxyphenyl)-3-formyl-4-hydroxy-5-(prop-1-en-1-yl)benzofuran (46), iteafuranal A) and (*E*)-2-(3-hydroxy-4-methoxyphenyl)-3-formyl-4-hydroxy-5-(prop-1-en-1-yl)benzofuran (47)**,** iteafuranal B) extracted from aerial parts of "*Itea ilicifolia"* showed DPPH free radical scavenging capacity with an IC_{50} value of 0.34 mg/mL [22]. These Compounds showed ABTS cation radical scavenging capacity with IC_{50} values of 0.23 and 0.30 mg/mL, respectively. Two new compounds, (7R,8S)-3,5'-dimethoxy-4',7-epoxy-8,3'-neolignane-5,9,9'-triol (48) and (2R)-12-hydroxy-4-methoxy-tremeton (49) isolated from aerial parts of "*Leontopodium leontopodioides"* were found to inhibit nitric oxide (NO) production in lipopolysaccharide-activated RAW264.7 macrophages with IC_{50} values of 35.80 and 24.41 μM, respectively [23]. Benzofuran derivatives 1-(4,6-dihydroxy-2-((1R,2S)1,2,3-trihydroxy-1-(2,4,6-trihydroxy-5-(3-methyl butanoyl)cyclohexa-1,3-dien-1-yl) propyl)-5,6-dihydrobenzofuran-7-yl)-3-methylbutan-1-one (50) and 3-methyl-1-((2S,3'S,4'R,5'R)-3',4,4',5',6-pentahydroxy-3a,3',4',5',6',7a-hexahydro-3H-spiro[benzofuran-2,2'-pyran]-7-yl) butan-1-one (51) obtained from roots of *Lysidice rhodostegia* exhibited potent antioxidative activity with IC_{50} values of 3.29 and 3.39 μM, respectively [24]. 2-arylbenzofuran (52) extracted from root bark, stem bark and leaves of *Morus alba* reduced the oxidation of low-density lipoprotein (LDL's) responsible for atherogenesis [25]. Three novel benzofuran derivatives, i.e., (2*R*)-(4-methoxybenzyl)-5,7-dimethyl-6-hydroxyl-2,3-dihydrobenzofuran (53), 2-(2-hydroxyl-4-methoxy-benzyl)-5-methyl-6-methoxyl-2,3 dihydrobenzofuran (54), and 2-(4-hydroxy-benzyl)-5,6 dihydroxybenzofuran (55) and two known compounds 2-(4-methoxy-benzyl)-6,7-dimethoxyl-2,3-dihydrobenzofuran (56) and 2-(4-methoxybenzyl)-6,7-methylenedioxy-2,3-dihydrobenzofuran (57) extracted from the tubers of *Ophiopogon japonicus* revealed the effects on production of NO induced by LPS (lipopolysaccharide) in RAW264.7 cells [26]. Furthermore, two novel 2-arylben-

zofuran dimers, shandougenines A (58) and shandougenines B (59) and six known benzofuran compounds, i.e., (60-65) isolated from ethanolic extract of *Sophora tonkinensis*, showed moderate to stronger DPPH free radical scavenging ability [27].

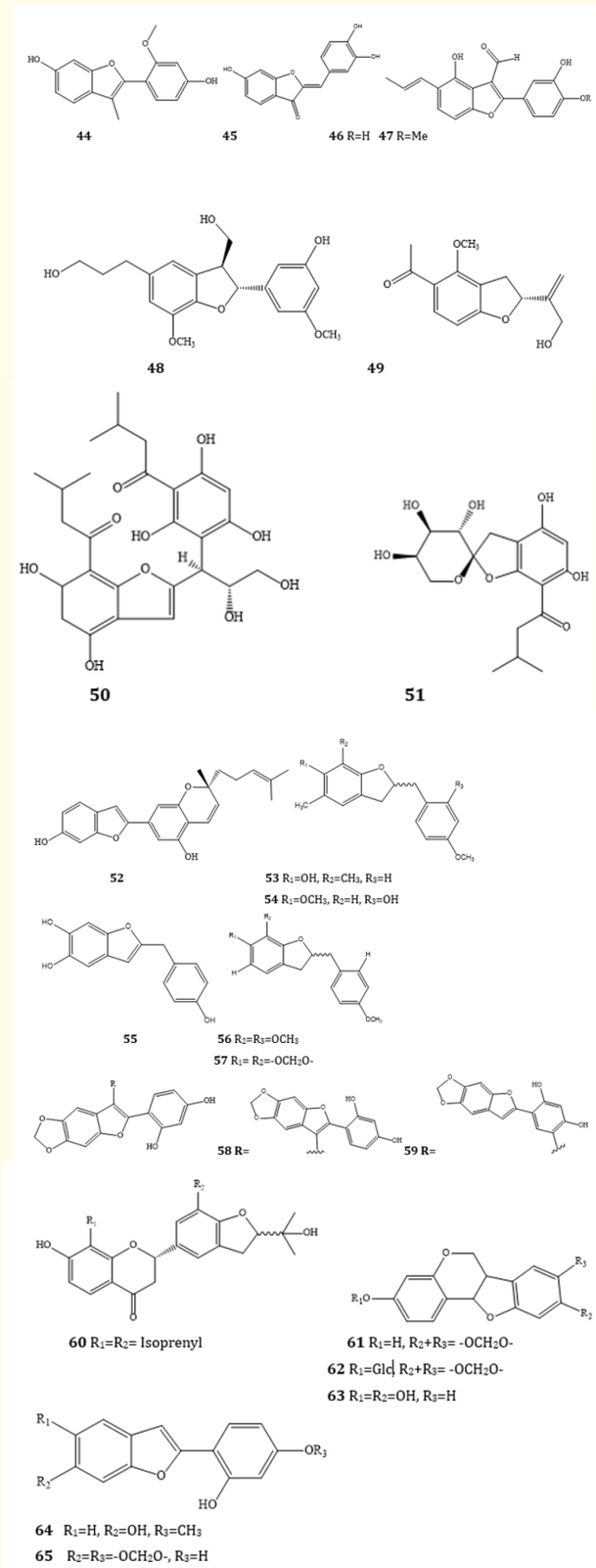


Figure 3

Anti-inflammatory-activity

Anti-inflammatory is a characteristic/property of a substance which decreases the effect of pain, fever, tenderness, or inflammation. Many benzofurans and their derivatives which are extracted from plant, animal, fungus species showed anti-inflammatory activities. Novel compounds 6-methoxy-3-methyl-2-phenylbenzofuran-5-ol (66) and 6-methoxy-2-methyl-3-phenylbenzofuran-5-ol (67) isolated from the heartwood of *Dalbergia odorifera* were shown to have protective effects against glutamate-induced oxidative injury in HT22 cells. These compounds were used in modulating the regulation of anti-inflammatory activity through the upregulation of heme oxygenase (HO)-1 in BV2 microglia [28]. Compound (68) isolated from the heartwood of *D.odorifera* inhibited the levels of proinflammatory mediators NO, PGE2, TNF-α and IL-1β with the results of decreased iNOS and COX-2 appearing when BV2 microglia were stimulated by LPS at the dose of 1 μg/mL. 3-(2-hydroxy-4-methoxyphenyl)benzofuran-6-ol (69) acted as a specific inhibitor of 5-lipoxygenase with an IC_{50} value of 0.08 μM against the soluble rat enzyme; however, it was inactive against cyclooxygenase. 6-methoxy-3-phenylbenzofuran-5-ol (70), displayed protective effects with EC_{50} value of (3.09 μM) [18]. Two novel compounds, (S)-1-((2S,3R)-2-(benzo[d][1,3]dioxol-5-yl)-3-(hydroxymethyl)-7-methoxy-2,3-dihydrobenzofuran-5-yl)propane-1,3-diol (71), (S)-3-((2S,3R)-2-(benzo[d][1,3]dioxol-5-yl)-3-(hydroxymethyl)-7-methoxy-2,3-dihydrobenzofuran-5-yl)-3-methoxypropan-1-ol (72) showed anti-inflammatory activity, which is isolated from *Breynia fruticosa* [29]. A known compound (73), isolated from *Breynia fruticose* showed anti-inflammatory activity [29]. Two known compounds (74) and (75) isolated from *Paeonia veitchii* showed anti-inflammatory activity [30].

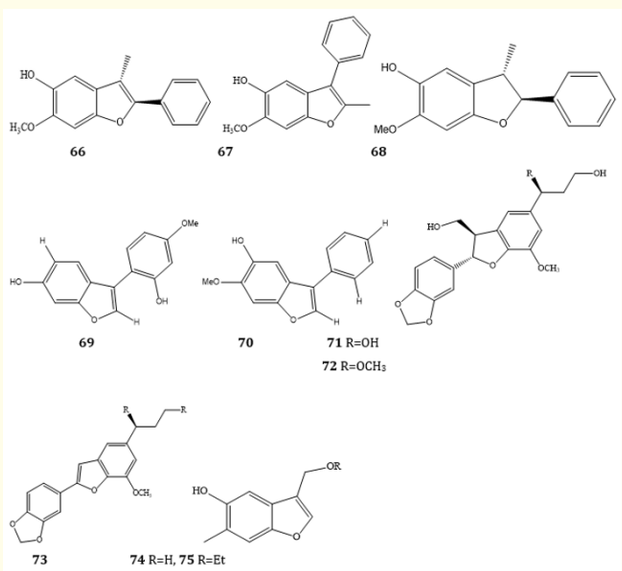
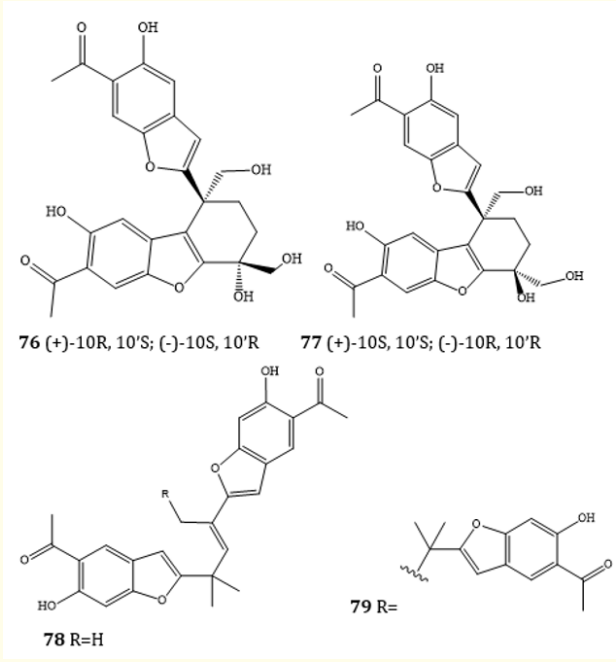


Figure 4

Anti-microbial activities

Seven new compounds, i.e., 1-(2-((1S,4R)-7-acetyl-4,8-dihydroxy-1,4-bis(hydroxymethyl)-1,2,3,4-tetrahydrodibenzo[b,d] furan-1-yl)-5-hydroxybenzofuran-6-yl)ethanone (76), 1-(2-((1S,4S)-7-acetyl-4,8-dihydroxy-1,4-bis(hydroxymethyl)-1,2,3,4-tetrahydrodibenzo[b,d]furan-1-yl)-5-hydroxybenzofuran-6-yl)ethanone (77), (E)-1,1'-(2,2'-(4-methylpent-2-ene-2,4-diyl) bis(6-hydroxybenzofuran-5,2-diyl))diethanone (78), (E)-1,1',1''-(2,2',2''-(2,6-dimethylhept-3-ene-2,4,6-triyl)tris(6-hydroxybenzofuran-5,2-diyl))triethanone (79), 1-(2-((1S,4R)-8-acetyl-4,7-dihydroxy-1,4-dimethyl-1,2,3,4-tetrahydrodibenzo[b,d] furan-1-yl)-6-hydroxybenzofuran-5-yl)ethanone (80), 8-acetyl-1-(5-acetylbenzofuran-2-yl)-7-hydroxy-1-methyl-2,3-dihydrodibenzo[b,d]furan-4(1H)-one (81), 1-(2-((1S,4S)-8-acetyl-4,7-dihydroxy-1,4-dimethyl-1,2,3,4-tetrahydrodibenzo [b,d] furan-1-yl)-6-hydroxybenzofuran-5-yl)ethanone (82) and seven known benzofuran derivatives (83-89), extracted from the plant *Eupatorium chinense* showed antiviral activities [31]. Four known benzofurans, (S)-2-methyl-2,3-dihydrobenzofuran-4-carboxylic acid (90), (S)-6-hydroxy-2-methyl-2,3-dihydrobenzofuran-4-carboxylic acid,(91), (S)-5,7-dichloro-6-hydroxy-2-methyl-2,3-dihydrobenzofuran-4-carboxylic acid (92), (S)-5,7-dichloro-6-methoxy-2-methyl-2,3-dihydrobenzofuran-4-carboxylic acid (93) isolated from *Pinus strobes* showed anti-microbial activity [32].



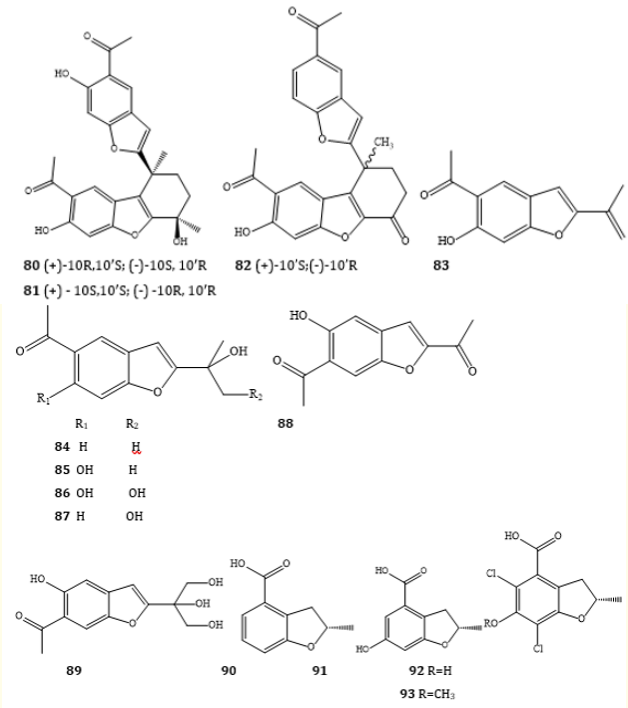
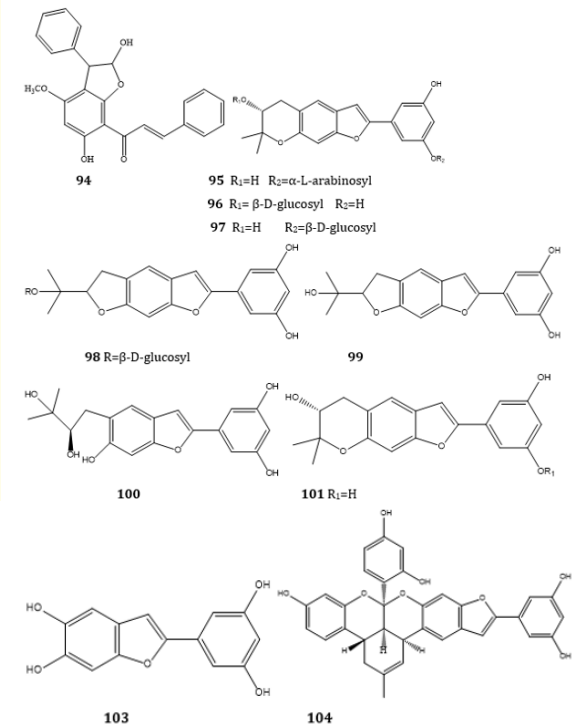


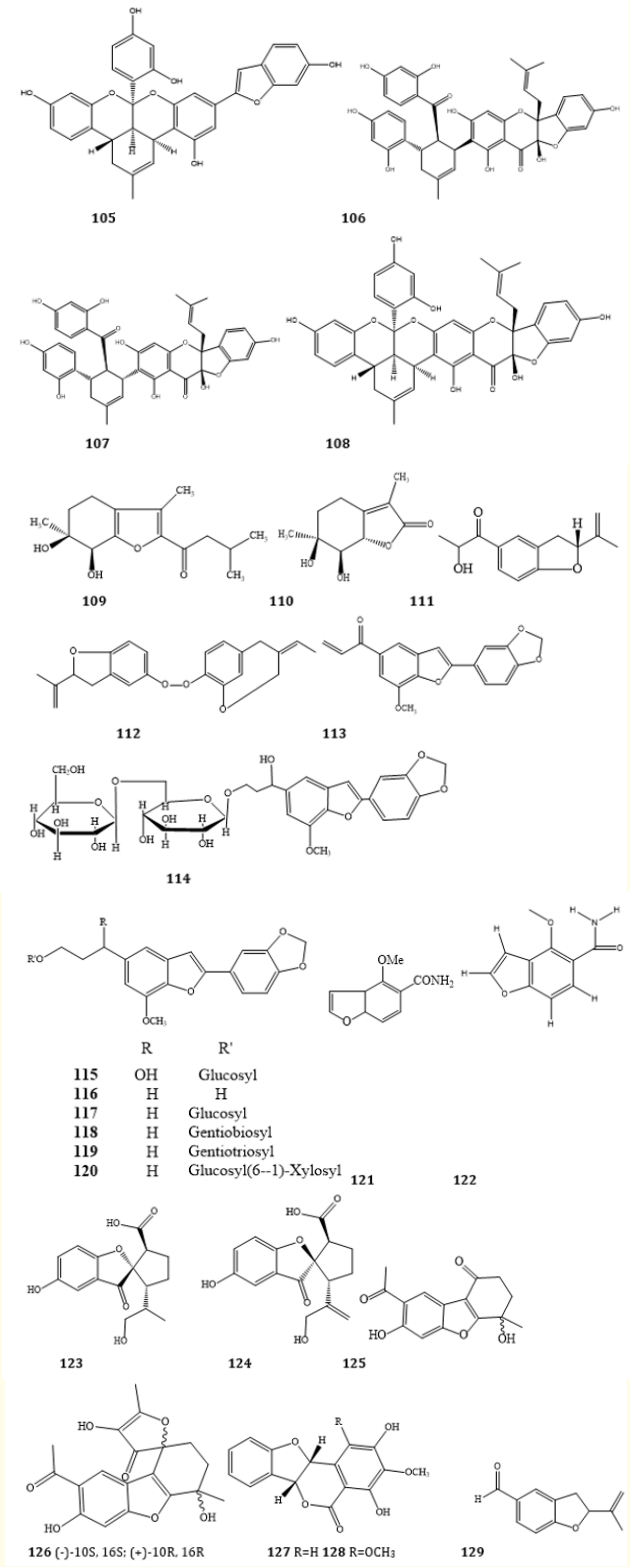
Figure 5

Other activities

Benzofurans exhibited miscellaneous activities i.e., edible, medicinal, mosquito-repellants, anti-fungal etc. A novel benzofuran-type compound, cathayenone A, i.e., (E)-1-(2,6-dihydroxy-4-methoxy-3-phenyl-2,3-dihydrobenzofuran-7-yl)-3-phenylprop-2-en-1-one (94), extracted from "*Carya cathayensis Sarg"* have germicidal effects (anti-fungal effects) on the pathogenic fungi [33]. Four novel compounds (9R)-moracin P 30-O-β-L-arabinopyranoside (95), (9R)-moracin P 9-O-β-D-glucopyranoside (96), (9R)-moracin P 30-O-β-D-glucopyranoside (97) and (9R)-moracin O 10-O-β-D-glucopyranoside (98) and ten known compounds, 5-(6-(2-hydroxypropan-2-yl)-5,6-dihydrobenzo[1,2-b:5,4-b']difuran-2-yl)benzene-1,3-diol (99), (R)-5-(5-(2,3-dihydroxy-3-methylbutyl)-6-hydroxybenzofuran-2-yl)benzene-1,3-diol (100),(R)-5-(6-hydroxy-7,7-dimethyl-6,7-dihydro-5H-furo[3,2-g]chromen-2-yl)benzene-1,3-diol (101), mulberroside C (102) 2-(3,5-dihydroxyphenyl)benzofuran-5,6-diol (103),4-((3aS,3a1R,8aR,14bS)-12-(3,5-dihydroxyphenyl)-6-hydroxy-2-methyl-3a,3a1,8a,14b-tetrahydro-3H-enzo[3,4] isochromeno[1,8-bc]furo[3,2-g]chromen-8a-yl)benzene-1,3-diol (104), (3aS,3a1R,8aR,13bS)-8a-(2,4-dihydroxyphenyl)-6-(6-hy-

droxybenzofuran-2-yl)-2-methyl-3a,3a1,8a,13b-tetrahydro-1H-benzo[3,4]isochromeno[1,8-bc]chromene-4,11-diol (105), (5aR,10aS)-2-((1S,2R,3S)-2-(2,4-dihydroxybenzoyl)-2',4'-dihydroxy-5-methyl-1,2,3,6-tetrahydro-[1,1'-biphenyl]-3-yl)-1,3,8,10a-tetrahydroxy-5a-(3-methylbut-2-en-1-yl)-5aH-benzofuro[3,2-b]chromen-11(10aH)-one (106), (5aR,10aS)-2-((1S,2R,3R)-2-(2,4-dihydroxybenzoyl)-2',4'-dihydroxy-5-methyl-1,2,3,6-tetrahydro-[1,1'-biphenyl]-3-yl)-1,3,8,10a-tetrahydroxy-5a-(3-methylbut-2-en-1-yl)-5aH-benzofuro[3,2-b]chromen-11(10aH)-one (107), sanggenon D (108) are extracted from the roots of *Cortex Mori Radicis* showed significant protective activities against glutamate-induced neurotoxicity. Correspondingly, they also exhibited remarkable analgesic activities by inhibition of the acetic acid-induced pain [34]. A new tetrahydrobenzofuran derivative, (6S,7S)-6,7-dihydroxy-3,6-dimethyl-2-isovaleroyl-4,5,6,7-tetrahydrobenzofuran (109) and a known benzofuran derivative, i.e., (6S,7R,7aS)-6, 7-dihydroxy-3,6-dimethyl-5,6,7,7a-tetrahydrobenzofuran-2(4H)-one (110) extracted from an edible mushroom fruit (*Lentinus squarrosulus)* used as health promoting benefits, and for the research community interested in bioactive compounds for further research [35]. Phenostereum (A), 2-hydroxy-1-((R)-2-(prop-1-en-2-yl)-2,3-dihydrobenzofuran-5-yl)propan-1-one (111) and novel phenostereum (B), 2-hydroxy-1-((R)-2-(prop-1-en-2-yl)-2,3-dihydrobenzofuran-5-yl)propan-1-one (112), extracted from fungus (*Stereum* sp.*)* have larvicidal compounds that can be used to control mosquitoes [36]. Furthermore, benzofuran derived from "*Styrax perkinsiae"* 5-(2-Propen-1-one)-7-methoxy-2-(3,4methylenedioxyphenyl) benzofuran (113), 1''-hydryoxyegonol gentiobioside (114) and six known six compounds, Obassioside B (115), egonol (116), egonol glucoside (117), egonol gentiobioside (118), egonol gentiotrioside (119), and masutakeside (120) showed medicinal value [37]. A novel benzofuran compound, 4-methoxy-3a,7a-dihydrobenzo furan-5-carboxamide (121), extracted from the plant *Tephrosia purpurea,* revealed anti-allergic activity [38]. Similarly, another benzofran derivative, i.e., 4-methoxybenzofuran-5-carboxamide (122) also extracted from the plant of *Tephrosia purpurea*, revealed anti-allergic activity [39]. Biological screening studies indicated that benzofurans displayed a moderate activity against *Staphylococcus aureus,* which may be due to the existence of a modified eremophilane skeleton. Compounds (1'S,2'S,5'R)-5-hydroxy-5'-((R)-1-hydroxypropan-2-yl)-3-oxo-3H-spiro[benzofuran-2,1'-cyclopentane]-2'-carboxylic acid (123) (1'R,2'S,5'R)-5-hydroxy-5'-(3-hydroxyprop-1-en-2-yl)-3-oxo-3H-spiro[benzofuran-2,1'-cyclopentane]-2'-carboxylic acid (124) exhibited from fruits of "*Ganoderma lingzhi"*, are used for the treatment and prevention of many diseases and acts as anti-fungal agent. It is an edible, very effective and medicinal fungus [40]. Two novel compounds, 8-acetyl-4,7-dihydroxy-4-methyl-3,4-dihydrodibenzo[b,d]furan-1(2H)-one (125), 8-acetyl-4,4',7-trihydroxy-4,5'-dimethyl-3,4-dihydro-2H,3'H-spiro[dibenzo[b,d]furan-1,2'-furan]-3'-one (126), isolated from *Eupatorium chinense* used as folk medicines [41]. Two novel compounds, (6aR,11aR)-2,4-dihydroxy-3-methoxy-6a,11a-dihydro-5H-benzofuro[3,2-c]isochromen-5-one (127), (6aR,11aR)-2,4-dihydroxy-1,3-dimethoxy-6a,11a-dihydro-5H-benzofuro[3,2-c]isochromen-5-one (128) showed Oestrogenic and anti-platelet activities, which is isolated from *Liriope platyphylla* [42]. 2-(prop-1-en-2-yl)-2,3-dihydrobenzofuran-5-carbaldehyde (129) isolated from *H. annosum s.s. and H. irregulare* [43], shoreaketone (130)1a and (131) 1b extracted from *Dipterocarpaceaeous* [44], showed miscellaneous activity. Compound (132), also showed antifungal agents [45]. 2-(2,3-dihydroxy-5-methoxyphenyl)-6-hydroxybenzofuran-3-carbaldehyde (133) and 2-(2,3-dihydroxy-5-methoxyphenyl)-6-methoxybenzofuran-3-carbaldehyde (134) were extracted from *S. Grandiflora* also exhibited anti-fungal properties [46].





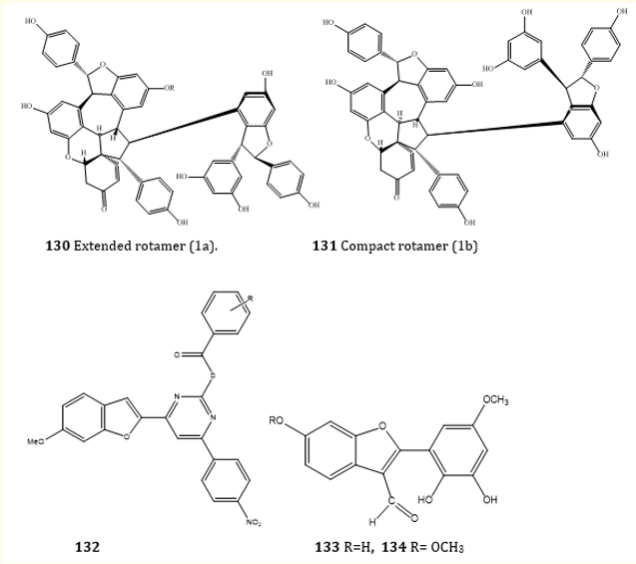


Figure 6

Conclusion

Benzofurans and its derivatives have enormous potential to find importance in medicinal chemistry and display multiple biological activities. They developed as a cancer chemo-preventive agent and be useful in cancer therapy to sensitize tumor cells. Many efficient clinical drugs are developed by modifying the benzofuran derivatives. They are playing vital role in HIV treatment, and acts as anti-viral, anti-microbial, anti-fungal, anti-allergic activities. They are used as in oestrogenic, anti-platelet activities, and in modulating the regulation of anti-inflammatory activities. They also help in enzyme inhibition and acts as mosquito repellants too. In short, we can say that benzofuran derivatives show tremendous health benefits, which showed numerous scopes in medicinal, pharmaceutical industrial branches.

Conflict of Interest

None.

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