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## **A SYSTEMATIC REVIEW OF THE GENUS FICUS IN UTTARAKHAND: PHYTOCONSTITUENTS AND THERAPEUTIC APPLICATIONS**

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### **ABSTRACT**

Uttarakhand is the state located at the foothills of the snow-clad Himalayas with lush green vegetation. There is a diverse range of flora and fauna habitats in Uttarakhand. The State has rich and diverse floral, faunal and microbial wealth including rare and threatened species of plants and animals. The genus *Ficus* belongs to the Moraceae family comprising approximately 750 species in tropical and subtropical regions in India; 27 species in Uttarakhand. Many *Ficus* species have been used as ethnopharmacological for the treatment of many diseases. This comprehensive review describes the *Ficus* species present in Uttarakhand for the phytochemical compounds and contemporary pharmacological activities such as antioxidant, cytotoxic, antimicrobial, anti-inflammatory, antidiabetic, antiulcer, and anticonvulsant. An extended survey of the current literature (Science Direct, Scopus, and PubMed) has been carried out as part of the current work. The present review may provide useful evidence for reasonable utilization of *Ficus* species as phytochemical, and pharmacological studies for drug innovation.

**Keywords; *Ficus* species, antidiabetic, anti-inflammatory, antimicrobial, phytoconstituents and  
Pharmacological active compounds**

## INTRODUCTION

Uttarakhand has been traditionally known as the gold mine of medicinal plants and has declared as the herbal state in 2003 [1]. About 700 species of medicinal plants are found in the state of which 682 species are angiosperm, 12 are gymnosperm and 7 species are fern [2] that are used in drug and pharmaceutical industries as well as also used in Ayurvedic, Unani, and other traditional systems of medicine [3].

Moraceae, the fig family have monoecious or dioecious trees, shrubs, and lianas, nearly all are milky sap [4]. Figs are one of the most ancient foods cultivated by a human. The importance of *Ficus* as a global divine and material resource for humans has been substantiated [5]. They are traditionally used as sources of medicines [6], food, ornamental trees, religious plants, lac hosts, fodder, fuel, and hedgerow [7]. The fig species of greatest commercial importance. Many of these species belong to auxiliary aerial root systems extending to the ground from their branches or trunks [8]. All *Ficus* species possess latex-like material that protects and self-healing from physical aggression [9]. A genus of about 750 species in tropical and subtropical regions; 115 taxa (89 species and 26 infraspecific taxa) in India; 27 species in

Uttarakhand. These are *Ficus arnottiana*, *auriculata*, *benghalensis*, *krishnae*, *carica*, *drupacea*, *elastica*, *hederacea*, *heterophylla*, *hispida*, *squamosa*, *microcarpa*, *neriifolia*, *nervosa*, *oligodon*, *palmate*, *pubigera*, *pumila*, *sarmentosa*, *semicordata*, *subincisa*, *tinctoria*, *virens*, *religiosa*, *racemosa*, *rumphii* and *retusa* [10-12]. This review covers the 17 species of genus *Ficus* from Uttarakhand based on their phytochemical composition and biological activities.

### Phytoconstituents

This review includes 34 Phytosterol, 30 amino acids, and organic acids, 21 fatty acids, and esters, 43 flavonoids, 56 phenolic compounds, 37 pheophytin, 120 terpenoids, 31 linear compounds, 5 alkaloids, 53 miscellaneous compounds, were reported from the genus *Ficus*. Most of them were investigated for various biological activities.

#### • Phytosterols

Thirty-four sterols were obtained from the genus *Ficus*. Phytosterols are the collective term for plant-derived sterols and stanol esters that are found in the fatty tissues of plants. The commonly occurring sterols are stigmasterol, sitosterol, and glycosides. The sterols isolated from the *Ficus* genus are listed in **Table 1**.

Table 1: Phytosterols from the genus *Ficus*

| Ficus species         | Compounds name  | Part used                     | References |
|-----------------------|---|-------------------------------|------------|
| <i>F.benghalensis</i> | Lanostadienyl glucosyl cetoleate, bengalensisteroic acid acetate, $\beta$ -sitosterol   | Stem-bark, leaves             | [13]       |
| <i>F.religiosa</i>    | lanosterol, $\beta$ -sitosterol and its glucoside ( $\beta$ -sitosteryl-d-glucoside), Stigmasterol, serotonin (5-hydroxytryptamine), Campesterol, Sitosterol, 28-isofucoesterol   | Bark, leaves, Fruit and latex | [14-18]    |
| <i>F.carica</i>       | lanosterol, Betulol, 6-O-Acyl-b-D-glucosylsitosterols, 24-methylenecycloartanol, $\Psi$ -taraxasterol ester,  | Leaves, latex                 | [19-21]    |
| <i>F.nervosa</i>      | Stigmasterol, $\beta$ -sitosterol, ergosterol peroxide 6 $\beta$ -hydroxystigmast-4-en-3-one 6 $\beta$ -hydroxystigmast-4,22-dien-3-one   | roots                         | [22]       |
| <i>F.auriculata</i>   | Stigmasterol  | Fig, leaves                   | [23]       |
| <i>F.microcarpa</i>   | Stigmasterol, $\beta$ -sitosterol, Daucosterol, Ergosterol peroxide, 6 $\beta$ -Hydroxystigmast-4-en-3-one, $\beta$ -Sitostenone, $\beta$ -Sitosterol, 3-O-(6'-octadecanoyl) $\beta$ -D-glucopyranoside, 6'-( $\beta$ -Sitosteryl-3-O- $\beta$ glucopyranosidyl)hexadecanoate, $\alpha$ -Tocopheroids, $\alpha$ -Tocopherol $\alpha$ -Tocospiros A, B | Aerial root, bark, leaves     | [24-26]    |
| <i>F.retusa</i>       | sitosterol acetate  | Aerial part                   | [27]       |
| <i>F.pumilia</i>      | $\beta$ -sitosterol   | Leaves, bark                  | [28]       |
| <i>F.racemosa</i>     | lanosterol, Stigmasterol, Euphol, Isoeuphorbol, 4-deoxyphorbol, Cycloartenol Cycloeuphordenol, $\beta$ -sitosterol, Glunol acetate Racemosic acid   | Stem-nark, leaves             | [29-34]    |

#### • Amino Acids And Organic Acids

A large number of amino acids, their derivatives, and organic acids were isolated from genus *Ficus*. Amino acids, monomers of peptides and proteins, have extensive industrial applications. Most of the organic

acid is isolated from *F.carica*. The commonly occurring amino acids are cysteine, glutamine, and methionine. The amino acids isolated from *Ficus* species are listed below in Table 2.

Table 2: Amino Acids and Organic Acids from genus *Ficus*

| Ficus species         | Compound name  | Part used      | References |
|-----------------------|--|----------------|------------|
| <i>F.benghalensis</i> | Cysteine, Glutamine, Methionine, Tryptophan, Arginine, Citruline, Hydroxyproline   | Fruits         | [35]       |
| <i>F.religiosa</i>    | Cysteine, Methionine, Arginine, Alanine, Serine, Glycine, Ornithine, Tyrosine, aspartic acid, Threonine, Proline, Tyrosine, Valine, Isoleucine, Lysine   | leaves         | [36]       |
| <i>F.racemosa</i>     | Methionine, Tryptophan, Arginine, Leucine, Histidine, Asparagine, Alanine, Serine, Glycine, Tyrosine, aspartic acid, Threonine, Proline, Tyrosine, Valine, Isoleucine                            | Leaves, fruits | [37]       |
| <i>F.carica</i>       | Cysteine, Glutamine, Phenylalanine, Leucine, Histidine, Asparagine, Alanine, Serine, Glycine, Ornithine, Tyrosine, Oxalic acid, citric acid, malic acid, quinic acid, fumaric acid shikimic acid | Latex, leaves  | [19],[38]  |
| <i>F.auriculata</i>   | caffeic acid   | Fruits         | [39]       |

### • Fatty Acids And Esters

Twenty-one fatty acids were reported from *Ficus* species. The latex of *F. carica* has yielded the highest number of fatty acids in *Ficus* species. Palmitic acid and stearic acid notably the major fatty acid component in

*Ficus* was isolated from seed oil and latex of *F. bengalensis* and *F. carica*, Fatty acid esters are a type of esters that result from the combination of fatty acid with alcohol are listed in **Table 3**.

**Table 3: Fatty acids and esters from the genus *Ficus***

| Ficus species         | Compound name  | Part used | References |
|-----------------------|--|-----------|------------|
| <i>F. bengalensis</i> | Palmitic acid, myristic acid, sterculic acid, lauric acid, malvalic acid, stearic acid, vernolic acid, linolenic acid, oleic acid,   | Seed oil  | [40]       |
| <i>F. carica</i>      | Palmitic acid,, myristic acid, stearic acid, linoleic acid, oleic acid, pentadecylic acid, margaric acid, cis-10 heptadecenoic acid, elaidic acid, arachidic acid, heneicosylic acid, behenic acid, tricosylic acid, lignoceric acid | latex     | [19]       |
| <i>F. arnottiana</i>  | Sulfurous acid, Octadecyl 2-propyl ester   | leaves    | [41]       |

### • Flavonoids

Flavonoids are the largest group of naturally occurring phenolic compounds, which occur in different plant parts both in free state and as glycosides. Forty -three flavones and

flavonols collectively called flavonoids have been identified in the genus *Ficus*, with quercetin and kaempferol as the primary flavonoids. Flavanoids are isolated from *Ficus* species in the **Table 4**.

**Table 4: Flavanoids from the genus *Ficus***

| Ficus species         | Compound name   | Part used                                    | References         |
|-----------------------|---|--|--------------------|
| <i>F. bengalensis</i> | Catechin, Genistein, quercetin-3-galactoside, Rutin,  | Leaves                                       | [42],[13]          |
| <i>F. elastica</i>    | Myricetin   | Leaves                                       | [43]               |
| <i>F. retusa</i>      | Catechin, Luteolin, Afzelechin,   | aerial part,                                 | [44],[27]          |
| <i>F. religiosa</i>   | Kaempferol, Myricetin, quercetin  | Fruits                                       | [45]               |
| <i>F. sarmentosa</i>  | Eriodictyol, Apigenin,  | leaves and stem                              | [46]               |
| <i>F. nervosa</i>     | Genistein, Apigenin, Carpachromene, parvisoflavone B, Alpinumisoflavone, 2'-hydroxygenistein, Prunetin, Cajanin, (2S)-naringenin,   | Root   | [22]               |
| <i>F. carica</i>      | Luteolin, biochanin-A, luteolin-6C-hexose-8C-pentose, apigenin rutinoside, Kaempferol rutinoside, Quercetin rutinoside, Quercetin glucoside, Quercetin acetilglucoside,   | leaves and stem                              | [30],[47], [48]    |
| <i>F. pumila</i>      | Luteolin, Hesperitin, Chrysin, Taxifolin, Tricetin, 7,4'-dimethoxy-5-hydroxyiso#avone, 5,7,2',5'-tetrahydroxy#avanone,  | leaves and stems                             | [28]               |
| <i>F. microcarpa</i>  | Catechin, Genistein, Rutin quercetin, Apigenin-6-C-glucoside, Apigenin-8-C-glucoside (vitexin), Luteolin-8-C-glucoside (orientin, Isovitexin-3"-O-glucopyranoside, Isosaponarin, Isolupinisoflavone E*, Ficusol, Ficusoflavone, Epicatechin, Ficuglucoside, Luteolin 6-C-β-D-glucopyranoside, | leaves, bark, aerial root , fruit, heartwood | [24],[25], [49-53] |

### • Phenolic Compounds

Phenolic compounds are a group of small molecules characterized by their structure having at least one phenol unit. Fifty-six phenolic compounds were recorded from *Ficus*. Phenolic compounds consist of

phenolic acid and coumarin. Gallic acid, ellagic acid, ferulic acid, and Coumaric acid were isolated from *Ficus* species. Phenolic compounds isolated from *Ficus* species were summarized in the **Table 5**.

Table 5: Phenolic compounds from the genus *Ficus*

| Ficus species         | Compound name  | Part used             | References |
|-----------------------|--|-----------------------|------------|
| <i>F.microcarpa</i>   | Catechol, Coumarin, Isovanillic acid, Methyl chlorogenate, Procyanidins B1, B3, p-Propylgualiacol, p-Propylphenol, 4-n-Propylresorcinol, Protocatechuic acid, Syringaldehyde, Syringol, Vanillin, Vanillin   | Bark, aerial root     | [53-56]    |
| <i>F.religiosa</i>    | Vitamin K1, n-octacosanol, methyl oleate lupin-3-one, Bergapten, Bergaptol,  | bark                  | [57]       |
| <i>F.racemosa</i>     | Vitamin K1, Bergapten, Bergaptol,  |                       | [37],[58]  |
| <i>F.carica</i>       | Bergapten, 3-CQA (3-O-caffeoylquinic acid), 5-CQA (5-O-caffeoylquinic acid), Q-3-Glu (quercetin 3-O-glucoside), Q-3-rut (quercetin 3-O-rutinoside), ferulic acid, Pyrogallol, Pinostrobin Cinnamic, Vanillin, Protocatechol, Galangin, Chrysin Pinoembrine, Phenolptethlin, Coumaric, 3-5,-dimethoxy, Phenol | Latex, leaves, fruits | [59],[19]  |
| <i>F.nervosa</i>      | hydroxyxanthyletin, 3-methoxyxanthyletin, Xanthyletin, Umbelliferone, Scopoletin, (b)-(S)-marmesin   | roots                 | [22]       |
| <i>F. retusa</i>      | Retusaphenol, Retusa afzelechin trimer   | Aerial part           | [27]       |
| <i>F.sarmetosa</i>    | 7-hydroxycoumarin  | Stem and leaves       | [46]       |
| <i>F.benghalensis</i> | Leucocyanidin  | leaves                | [60],[61]  |
| <i>F.rumphii</i>      | 1-isopentyl 3,4dioxomethylene-2-phenol, (2-Hydroxyphenyl)-1-(piperidin-1-yl) propan-1-one (4)  | leaves                | [62]       |
| <i>F.auriculata</i>   | Scopoletin   | leaves                | [23]       |
| <i>F.pumila</i>       | Bergapten  | Leaves and stem       | [28]       |

### • Pheophytins

Thirty-seven pheophytin was reported in the *Ficus* species. In the pheophytin group

Anthocyanin and Anthocyanin derivatives are also present. The pheophytin isolated from *Ficus* species is given in the **Table 6**.

Table 6: Pheophytin from the genus *Ficus*

| Ficus species    | Compound name  | Part used | References |
|------------------|--|-----------|------------|
| <i>F. carica</i> | Cyanidin-3-rhamnoglucoside, cyanidin-3-glucoside, cyanidin-3,5-diglucoside, cyanidin-3-rutinoside, pelargonidin-3-glucoside, cyanidin 3-rutinoside dimmer cyanidin 3-malonylglucoside, peonidin 3-rutinoside, pelargonidin 3-rutinoside Pelargonidin 3-glucoside, cyanidin 3-malonylglucosyl-5-glucoside, carboxypyranocyanidin 3-rutinoside, (epi)catechin-(4→8)-pelargonidin 3-rutinoside, (epi)catechin-(4→8)-cyanidin 3-rutinoside cyanidin 3,5-diglucoside, | Fruit     | [63-65]    |

|                       |  |           |                |
|-----------------------|--|-----------|----------------|
|                       | (epi)catechin-(4→8)- cyanidin 3-glucoside, Cyanidin-3-O-glucoside,cyanidin-3- O-rhamnoglucoside  |           |                |
| <i>F.microcarpa</i>   | Aristophyll-C,132 (R)-Hydroxypheophytin a, 132 (S)- Hydroxypheophytin a, 132 (R)-Hydroxypheophyton a, 132 (S)-Hydroxypheophyton a,1322 (S)-Pheophyton a,132 (R)-Pheophyton a, Pyropheophytin a   | leaves    | [66]           |
| <i>F. racemose</i>    | leucocyanidin 3 O β D glucopyrancoside, leucopelargonidin 3 O β D glucopyranoside, leucopelargonidin 3 O β D glucopyranoside,leucopelargonidin 3 O α L rhamnopyranoside  | Stem-bark | [58]           |
| <i>F.elastica</i>     | Emodin   | leaves    | [43]           |
| <i>F.benghalensis</i> | Pelargonidin,5,7-dimethylether of leucopelargonidin-3-O-α-L-rhamnoside, 3',5,7-trimethyl ether of delphinidin-3-O-α-L-rhamnoside,3',5,7-trimethylether of leucocyanidin,3',5-dimethyl ether of leucocyanidin-3-O-β Dgalactosylcellobioside | Stem-bark | [67],[35],[13] |
| <i>F.drupacea</i>     | Xanthophyll  | leaves    | [68]           |

### • Terpenoids

Terpenoids are secondary metabolites synthesized by plants. Terpenoids find wide application in industry Taxol is an anti-tumor compounds. Moreover, insects use many terpenoid-derived molecules for their communications One hundred and twenty Terpenoids are reported from Ficus species.

The sesquiterpenes  $\alpha$ -copaene,  $\alpha$ -

cubebeneand  $\alpha$ -ylangene from, *F.religiosa*, and *F.carica* were reported . The majority of the triterpenoids have one of the skeleton types, taraxastane, lupine, oleanane, ursane, and friedelin. The highest numbers of terpenoids were reported from the aerial root, leaves, and bark of *F.microcarpa* are given in **Table 7**.

**Table 7: Terpenoids from the genus Ficus**

| Ficus species       | Compound name   | Part used                           | References         |
|---------------------|---|-------------------------------------|--------------------|
| <i>F.religiosa</i>  | $\alpha$ -pinene, $\beta$ -pinene, $\alpha$ -terpinene, Limonene, (Z)- $\beta$ -ocimene, (E)- $\beta$ -ocimene, Camphene, Perillene, $\alpha$ -cubebene, $\alpha$ -ylangene, $\alpha$ -copaene, $\beta$ bourbonene , $\beta$ -caryophyllene, $\alpha$ -bergamotene, aromadendrene, $\alpha$ -humulene, germacrene D bicyclogermacrene, $\gamma$ -cadinene, $\delta$ -cadinene, dendrolasine $\alpha$ -ylangene, $\beta$ -bourbonen, $\beta$ -caryophyllene, $\alpha$ -trans bergamotene, alloaromadendrene, Germacrene, Lupeol, $\alpha$ -amyrin, $\beta$ -amyrin   | Fruits, leaves                      | [69-71]            |
| <i>F.microcarpa</i> | ficusic acid, 3 $\beta$ -Acetoxy-11 $\alpha$ ,12 $\alpha$ -epoxy-16-oxo-14-taraxerene,3 $\beta$ -Acetoxy-11 $\alpha$ ,12 $\alpha$ -epoxy-14-taraxerene,3 $\beta$ -Acetoxy-20 $\alpha$ ,21 $\alpha$ -epoxytaraxastane,3 $\beta$ -Acetoxy-20 $\alpha$ ,21 $\alpha$ -epoxytaraxastan-22 $\alpha$ -ol,3 $\beta$ -Acetoxy-21 $\alpha$ ,22 $\alpha$ -epoxytaraxastan-20 $\alpha$ -ol,3 $\beta$ -Acetoxy-19 $\alpha$ -hydroperoxy-20-taraxastene,3 $\beta$ -Acetoxy-19 $\alpha$ -methoxy-20-taraxastene, 3 $\beta$ -Acetoxy-22 $\alpha$ -methoxy-20-taraxastene,3 $\beta$ -Acetoxy-19(29)-taraxastan-20 $\alpha$ -ol,3 $\beta$ -Acetoxy-20-taraxastan-22 $\alpha$ -ol,3 $\beta$ -Acetoxy-20-taraxastan-22-one 3,22-Dioxo-20-taraxastene*,20 $\alpha$ ,21 $\alpha$ -Epoxytaraxastan-3 $\beta$ -ol | Heartwood, Bark, Aerial root,leaves | [50],[24], [72-81] |

|                       |  |                              |           |
|-----------------------|--|------------------------------|-----------|
|                       | 22-Oxo-20-taraxasten-3 $\beta$ -ol, Ptiloepoxide, 20-Taraxasten-3 $\beta$ -ol 20(30)-Taraxastene-3 $\beta$ ,21 $\alpha$ -dio 20-Taraxastene-3 $\beta$ ,22 $\alpha$ -dio, Taraxerol, Teraxerone, Lupeol, Lupeone, Lupeol acetate, Betulinic acid, Acetyl betulinic acid, Lupenyl acetate, Betulonic acid, oleanolic acid, Oleanonic acid, Ursonic acid, Ursolic acid, 12-Ursene-3,11-dione, Acetylursolic acid, Friedelin, Friedelinol Glutinol, Epifriedelinol, $\beta$ -Amyrin acetate $\alpha$ -Amyrone, Canophyllol, 3 $\beta$ -Acetoxy-1 $\beta$ ,11 $\alpha$ -epidioxy-12-ursene, 3 $\beta$ -Acetoxy-11 $\alpha$ -ethoxy-12-oleanene, 3 $\beta$ -Acetoxy-11 $\alpha$ -ethoxy-12-ursene 3 $\beta$ -Acetoxy-12 $\alpha$ -formyloxy-13,27-cyclours-11 $\alpha$ -ol, 3 $\beta$ -Acetoxy-11 $\alpha$ -hydroperoxy-13 $\alpha$ H-ursan-12-one, 3 $\beta$ -Acetoxy-11 $\alpha$ -hydroperoxy-12-oleanene 3 $\beta$ -Acetoxy-11 $\alpha$ -hydroperoxy-12-ursene, (20S)-3 $\beta$ -Acetoxy-20-hydroperoxy-30-norlupane, 3 $\beta$ Acetoxy-18 $\alpha$ -hydroperoxy-12-oleanen-11-one, 3 $\beta$ -Acetoxy-11 $\alpha$ -hydroxy-12-oleanene, 3 $\beta$ -Acetoxy-11 $\alpha$ -hydroxy-12-ursene, 3 $\beta$ -Acetoxy-12-oleanen-11-one, $\beta$ -Acetoxy-12-ursene-11-one 3 $\beta$ -Acetoxy-12-ursene-11-one, Cycloart-23-ene-3 $\beta$ ,25-diol, Cycloart-25-ene-3 $\beta$ ,24-diol |                              |           |
| <i>F.carica</i>       | $\alpha$ -pinene, $\alpha$ -thujene, $\beta$ -pinene, Eucalyptol, Limonene, Tepinolene, cis-linalool oxide, Epoxylinool, $\beta$ -caryophyllene, $\alpha$ -guaiene, $\alpha$ -calacorene, Cadinene, Muurolene, $\alpha$ -caryophyllene $\alpha$ -bourbonene. Lupeol acetate, Lupeol, Bauerenol calotropenyl acetate, methyl maslinate, oleanolic acid, Ficusogenin, 6-O-Linoleyl-b-D-glucosyl-b-sitosterol, 6-O-Oleyl-b-D-glucosyl-b-sitosterol, 6-O-palmitoyl-b-D-glucosyl-b-sitosterol, $\alpha$ -amyrin, $\beta$ -amyrin  | Latex, leaves                | [19],[82] |
| <i>F.benghalensis</i> | Lupeol, Bengalensinone, benganoic acid, $\alpha$ -amyrin acetate   | Stem-bark, Aerial root       | [83],[13] |
| <i>F. racemose</i>    | Lupeol, Lupeol acetate, Lupenyl acetate, Taraxasterol, Lupenol   | Stem-bark, Fruit, trunk-bark | [30],[32] |
| <i>F.nervosa</i>      | Lupeol, Lupeone, oleanolic acid, $\alpha$ -amyrin, $\beta$ -amyrin, $\beta$ -friedelinol, Squalene, Cycloeucaenol  | leaves                       | [22]      |
| <i>F.drupacea</i>     | oleanolic acid, Epifriedelinol, $\beta$ -amyrin, $\beta$ -sitosterol-3-O- $\beta$ -D-glucopyranoside, 5-O methllatifolin, Friedelin, Epilupeol acetate Phaseic acid, Benzyl-O- $\beta$ -D-glucopyranoside  | Stem-bark, leaves            | [68],[84] |
| <i>F.retusa</i>       | Friedelinol, $\beta$ -Amyrin acetate   | Aerial part                  | [27]      |
| <i>F.pumila</i>       | Taraxasterol, $\alpha$ -amyrin   | Leaves, bark                 | [28]      |
| <i>F.krishnae</i>     | Cycloartenol+24-methylenecycloartanol  | Stem-bark                    | [85]      |

## Linear Compounds

Linear compounds such as linear acids, ketones, esters, carbohydrates, etc have been isolated from many species of *Ficus* along with long-chain hydrocarbons. Carbohydrates such as D-glucose, D-xylose, D-fructose, D-galactose and arabinose were

isolated from fruits and seeds of *F. benghalensis*. The majority of long-chain hydrocarbons were identified from the latex of *F.carica*. The important linear compounds isolated from the *Ficus* genus are listed in **Table 8**.

Table 8: Linear compound from the genus *Ficus*

| Ficus species          | Compound name   | Part used       | References |
|------------------------|---|-----------------|------------|
| <i>F. benghalensis</i> | D-glucose,D-xylose,D-fructose,D-galactose, D-arabinose  | Fruits and seed | [35]       |
| <i>F. religiosa</i>    | Undecane, Tridecane, Tetradecane, n-nonacosane, n-octacosanol, n-hexacosanol, n-hentriacontane, [Z]-3-hexenal 1-hexanol, [Z]-3-hexenyl acetate        | Fruits,leaves   | [86],[18]  |
| <i>F. carica</i>       | Pentanal, Hexanal, 6-methyl-5-hepten-2-one 1-heptanol, 1-hexanol, 1-pentanol, 1-butanol-2-methyl, 1-butanol-3-methyl ,octanal7 Benzaldehyde, Heptanal | latex           | [19]       |
| <i>F.krishnae</i>      | 3, 7, 11, 15-Tetramethyl-2-hexadecen-1-ol   | Stem-bark       | [87]       |
| <i>F. arnottiana</i>   | Tetratriacontane, Tritriacontane, Pentadecanal  | leaves          | [41]       |
| <i>F.elastica</i>      | sucrose   | leaves          | [43]       |

### • Alkaloids

Alkaloids are a chemically heterogeneous group of basic nitrogen-containing substances found in plants. Usually, the occurrence of a particular alkaloid is

localized to the seeds, leaves, bark, or roots of the plant and each site may contain closely related alkaloids. Five alkaloids have been isolated from *Ficus* spp. The alkaloids were reported in the **Table 9**.

Table 9: Alkaloids from the genus *Ficus*

| Ficus species      | Compound name  | Part used | References |
|--------------------|--|-----------|------------|
| <i>F.carica</i>    | Quinines   | fruits    | [21]       |
| <i>F.religiosa</i> | Piperine, methyl piperate, Dihydropiperloguminine, piperloguminine | leaves    | [16]       |

### • Miscellaneous Compounds

Fifty-three other kinds of compounds were also obtained from *Ficus* spp. Most of them were from *F.microcarpa* and others were

yielded from the stem-bark of *F. benghalensis*. The miscellaneous compound isolated from *Ficus* species in **Table 10**.

Table 10: Miscellaneous compound from the genus *Ficus*

| Ficus species          | Compound name  | Part used                                   | References              |
|------------------------|--|---|-------------------------|
| <i>F. benghalensis</i> | Meso inositol,β-sitosterol-α-D-glucose, 6-heptatriacontene-10-one,20-tetratriacontene-2-one, Pentatriacontan-5-one, Glutathione Tiglic acid ester of taraxasterol  | Stem bark, Fruit and seed, heartwood        | [35]                    |
| <i>F.microcarpa</i>    | Apocarotenoid, Ficusone, 4-(2-Methylbut-3-en-2-yl)-4'-methoxy-2,5-dihydroxychalcone, (GLx Chi) A–C, Ficuschlorins A–D, Ficusmicrochlorins A–C, Methyl-4-hydroxybenzoate, Methyl 4-hydroxy-3-methoxybenzoate, 4,5-Dihydroblumenol, Methoxybenzoate, Ficusolide diacetate Ficuspirolide, Ficusolide, Ficus A Ficusescuilignans A, B, Bridelionoside B Dihydroalangionoside A, Ficumegasoside (3S,5R,6R,7E,9S)-Megastigman-7-ene-3,5,6,9-tetraol, (7E,9Z)-Dihydrophaseic acid 3-O-β-D-glucopyranoside,2,2'-Dihydroxyl ether, Erythro-guaiacylglycerol, Erythro-guaiacylglycerol 9-O-β-D-glucopyranoside Ficuscarpanic acid, Ficuscarpanosides A, B* | Heartwood, Aerial root, Latex, leaves, bark | [88-94], [66],[24] [25] |

|                   |  |                                   |      |
|-------------------|--|-----------------------------------|------|
|                   | Icariside D2, Guaiacylglycerol, Guaiacylglycerol 9-O- $\beta$ -Dglucopyranoside*<br>3-(4-Hydroxy-3-methoxy phenyl) propan-1,2-diol 4-Methoxy guaiacylglycerol-7-O- $\beta$ -D-glucopyranoside, Syringin<br>(7S,8R)-Syringoylglycerol |                                   |      |
| <i>F.virens</i>   | n-Octadecanyl-O- $\alpha$ -D-glucopyranosyl(6 $\rightarrow$ 1 $\prime$ )-O- $\alpha$ -D-glucopyranoside  | leaves                            | [95] |
| <i>F.nervosa</i>  | 4-hydroxybenzaldehyde, (S)-lasiodiplodin<br>Vanillin   | roots                             | [22] |
| <i>F.elastica</i> | Morin, Ficusamide, Elasticoside, Ficusoside  | Leaves,<br>Bark of aerial<br>root | [43] |
| <i>F.hispida</i>  | ficushispimines A, ficushispimine C, ficushispidine  | Twigs                             | [96] |
| <i>F.krishnae</i> | 3-chloro-7-methoxy-4-methyl-chromen-2-on   | leaves                            | [97] |
| <i>F.retusa</i>   | Moretenone   | Aerial part                       | [27] |

### Biological activities of *Ficus* species and their isolated constituent

*Ficus* species contain a wide variety of secondary metabolites or compounds such as phytosterols, terpenoids, alkaloids, flavonoids that dictates the therapeutic potency and performs different pharmacological activities such as Antioxidant activity, Anti-inflammatory activity, Antidiabetic activity, Antibacterial activity, and Anticancer activity. Phytochemical investigations of some *Ficus* species revealed that phenolic compounds

constitute the major components them. Also, some studies reported the presence of antioxidant activity of some *Ficus* species which attributed the antioxidant activity to the phenolic content. Herbal medicines have started to gain importance as a source of hypoglycemic agents. Medicinal plants contain active principles which can be used as an alternative to cheap and effective herbal drugs against common bacterial infections. **Table 11** provides clarification of the bioactive compound isolated from *Ficus* species.

**Table 11: Pharmacological activities of some phytoconstituents reported in different species of genus *Ficus***

| S.No | <i>Ficus</i> species | Phytoconstituents  | Pharmacological activity   | References |
|------|----------------------|--|--|------------|
| 1.   | <i>F. carica.</i>    | 4',5'-Dihydropsoralen, umbelliferone, marmesin, bergapten, Scopoletin, Rutin<br>Quinines, Bauerenol, 24methylene cycloartanol, -taraxasterol ester, lupeol<br>Ficusogenin, Psoralen<br>$\beta$ -Sitosterol, Cyanidin-3-O-glucoside, cyanidin-3-O-rhamnoglucoside, 6-O-Linoleyl-b-D-glucosyl-b-sitosterol, 6-O-Oleyl-b-D-glucosyl-b-sitosterol, 6-O-palmitoyl-b-D-glucosyl-b- | Sunscreen agent, cytotoxic, photosensitizer<br>Anticancer, anemia, antioxidant, coloring agent, Antimalarial, antiprotozoal, chemopreventive, anti-inflammatory, tanning activator, and Hypolipidemic, hemoptysis, antiseptic activity | [21]       |

|     |                        |  |   |       |
|-----|------------------------|--|---|-------|
|     |                        | <b>sitosterol, Stilbenes</b>   |   |       |
| 2.  | <i>F. benghalensis</i> | Pelargonidin, $\alpha$ -myrin acetate, Catechin and genistein  | phenotypic variations, Antihyperglycemic activity, Antihyperlipidemic, hypocholesterolemic and antimicrobial activity | [98]  |
| 3.  | <i>F. racemosa</i>     | 3-O-(E)-Caffeoyl quinate, racemosic acid and $\beta$ -Sitosterol   | Antioxidant activity, Anti-inflammatory, antidiabetic activity  | [99]  |
| 4.  | <i>F. drupacea</i>     | 5-O-methylatifolin, epilupeol acetate,   | Antifungal and Antibacterial  | [100] |
| 5.  | <i>F. sarmentosa</i>   | hydroxycoumarin, apigenin, eriodictyol, quercetin  | Insecticidal activity   | [46]  |
| 6.  | <i>F. virens</i>       | n-Octadecanyl-O- $\alpha$ -Dglucopyranosyl(6' $\rightarrow$ 1'')-O- $\alpha$ -D-glucopyranoside  | enzymatic activity  | [95]  |
| 7.  | <i>F. nervosa</i>      | 3-Hydroxyxanthyletin, Xanthyletin, Umbelliferone, Scopoletin, Carpachromene, Genistein, Prunetin, Cajanin, Apigenin (2S)-Naringenin (S)-Lasiodiplodin, Ergosterol peroxide, Ethambutol                                     | Antimycobacterial activity  | [22]  |
| 8.  | <i>F. krishnae</i>     | cycloartenol+24-methylenecycloartanol  | Antidiabetic activity   | [85]  |
| 9.  | <i>F. auriculata</i>   | 5,7,4'-trihydroxy-3'-hydroxymethylisoflavone, 3'-formyl-5,4'-dihydroxy-7-methoxyisoflavon, ficuisoflavone, Alpinumisoflavon betulinic acid, sterols, lupeol, stigmastrol and $\beta$ -sitosterol-3-O- $\beta$ -D-glucoside | Antibacterial activity and Antiinflammatory activity  | [101] |
| 10. | <i>F. elastica</i>     | emodin, sucrose, morin, rutin, Ficusamide<br><br>Elasticoside  | antimicrobial activity<br><br>in vitro growth inhibitory activity and antibacterial activity                          | [43]  |
| 11. | <i>F. hispida</i>      | hispidin, $\beta$ -sitosterol, $\beta$ -amyrin, and bergaptin,   | Antioxidant activity  | [102] |
| 12. | <i>F. rumphii</i>      | 1-isopentyl-3,4-dioxomethylene-2-phenol, 3-(2-hydroxyphenyl)-1-(piperidin-1-yl) propan-1-one, stigmast-5-en-3-yl acetate and 3-acetyl-2H-chromen-2-one   | antiproliferative activity  | [62]  |
| 13. | <i>F. religosa</i>     | 4-methoxy-7H-furo[3,2-g]chromen-7-one (Bergapten) and 4-hydroxy-7H-furo[3,2-g]chromen-7-one (Bergaptol)  | antimicrobial activity  | [86]  |

## CONCLUSION AND FUTURE PERSPECTIVES

The *Ficus* spp. present in Uttarakhand have phytochemicals that make these plants useful for potential as alternative therapeutic applications. This review covers the phytoconstituents and various pharmacological activities of *Ficus* plants, in vitro, in vivo clinical studies. Several studies showed the antimicrobial, cytotoxic, antioxidant, and anti-inflammatory activities from phytochemicals present in *Ficus* spp. The advance in botanical research can elucidate the better-grown conditions of *Ficus* plants to obtain a better phytochemical composition. The genus *Ficus* has great potential, to date majority of the species, remain unknown or sparsely studied for the chemical constituents. It would be very necessary for photochemistry researchers to explore and examine more of its species. The vast pharmacological activities evinced by many compounds from the *Ficus* genus should attract the attention of the pharmacological community to determine their exact structure-activity relationships, objectives, and other medicinal applications.

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