IJRAR.ORG E-ISSN: 2348-1269, P-ISSN: 2349-5138

INTERNATIONAL JOURNAL OF RESEARCH AND ANALYTICAL REVIEWS (IJRAR) | IJRAR.ORG

An International Open Access, Peer-reviewed, Refereed Journal

PHYTOCHEMISTRY AND PHARMACOLOGICAL ACTIVITIES OF THE *GENUS RHYNCHOSIA*

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ABSTRACT: Lincosia species have played an important role in the historical use of Fabaceae family plants in traditional medicine. Phytochemical studies in species of this genus have isolated various compounds including flavonoids, isoflavonoids, faban-3-ols, xanthones, biphenyls, simple polyphenols and sterols. Some isolated compounds and plant extracts from rhynchosia seeds have interesting biological activities such as anticancer, antioxidant, antimicrobial, antibacterial, antimycobacterial, antityrosinase, anri-inflammatory and anti-angigenic activities. The author of this review believes that this genus is poorly understood and that further research on Rhynchosia species may reveal new natural compounds with strong biological activity. Phytochemical and pharmacological studies for this genus are important for this review, as only a few species have been studied.

KEYWORDS: Rhynchosia species, Phytochemistry, Flavonoids, Traditional uses, Pharmacological uses.

INTRODUCTION:

Natural compounds have attracted more attention and their use has become more widespread in many areas, such as the demand for products tested on animals, which affects both manufacturers and consumers [1]. Finally, our products must source raw materials that use safe and environmentally friendly processes. In this regard, the extraction and use of bioactive compounds obtained from plant matrices promises many applications, such as medicine, food and cosmetics, and makes plant extracts an alternative to synthetic and animal products. In addition, products can be produced using clean and safe methods that do not produce unwanted products [2].

Essential oils are secondary metabolites isolated from aromatic plants. It is widely distributed in roots, stems, leaves, flowers and fruits of plants and has a unique smell. It contains terpenes, oxidized terpenes, aromatic and phenolic compounds, has antioxidant, antibacterial, antifungal, anti-inflammatory, anti-viral, anti-cancer enzyme inhibitory effects, and various essential oils are used for different purposes. The production of pharmaceuticals, cosmetics and food supplements has been completed [3].

Genus Rhynchosia:

Lincosia species have played an important role in the historical use of *Fabaceae* family plants in traditional medicine. Of the approximately 300 species of the genus Linkosia found in tropical and subtropical regions of the world, India has 22 of them [4,5]. Species in the genus Linkosia in the *Fabaceae* family include herbs, shrubs, and erect shrubs. The genus Rhynchosia is a well-known genus that produces large amounts of C-glycosylflavonoids, as shown by preliminary phytochemical studies on several members of the genus. Antioxidant, anti-inflammatory, mycobacterial and anti-proliferative effects are interesting biological effects shown by chemical compounds and plant extracts isolated from the genus Rinchosia [7]. The purpose of this study is to provide an overview of the prevalence of drug use in relation to experience [8].

Some compounds isolated from Lincosia genus and plant extracts have shown interesting biological activities such as antioxidant, anti-inflammatory, mycobacterial and anti-proliferative activities [9-11]. A brief review of the chemical composition of rhynchosia seeds was published by our laboratory in 1991. However, this review only included some phytochemical reports and did not include medicinal aspects [12].

Figure 1: Image ofGenus Rhynchosia plant

Chemical Constituents:

Lincosia minima (L.)DC. (snout beans) is an annual, climbing or herbaceous plant belonging to the *Fabaceae* family. The stems are narrow, numerous and 80-120 cm long. The flower is yellow with purple veins, the fruit is 2 cm long [13]. Literature review, R. Minima contains essential oil, tannin, triterpene steroids, gallicacid, hydroquinone, protocatechuic acid, flavonoids, isovitaxin, orientin, chafoside, vicinin, vitexin, steroid glycosides, ergosterol peroxide and stearic acid. Lupeol plays a role [14-16]. It also exhibits several biological activities, including antibacterial, anticancer, α-glucosidase inhibition, and antileminitic activity [17-19]. On the other hand, it is reported to be rich in nutrients, especially nitrogen, so it is used as animal feed [20].

Traditional Uses of Genus Rhynchosia:

The genus Linkosia includes many plants used in indigenous medicine by indigenous tribes for various purposes such as antibiotic, antidiabetic, abortifacient, wound healing, hepatoprotective and rheumatology. Treatment of pain, boils and skin infections [7, 21]. Their use is based on folk medicine. For example, *Rhynchosiascarabaeods L*., also known as "common pea stone". This plant is used to treat various bacterial diseases such as dysentery, diarrhea and skin infections. In Pakistan, the plant *Rhynchosiapseudocajankambese* is used as a remedy for oxidative stress using its antioxidant principle [22]. These factories are spread all over the country. There are several species of the genus Linkosia, each of which has a bacterial nodule at the base. These nodules improve the soil and can be valuable for cultivation. Although some plants of the genus Lincosia are believed to have aromatic and toxic medicinal properties, the seeds of this plant are sometimes used medicinally by indigenous communities in southern Mexico [23].

REPORTED PHARMACOLOGICAL ACTIVITIES:

In recent decades, several species of Linkosia have been studied from a phytochemical and pharmacological point of view. Various compounds have been isolated so far. The extensive list of structures, names and chemical constituents reported so far from *S. rhynchosia* seed plant sources can be simplified into the following categories [24].

There are no previous pharmacological studies on the antifungal activity of R. minima extract. However, several species of the genus Lincosia have been reported to have different levels of antifungal activity against selected fungal species [25]. The minimum inhibitory concentration (MIC) test of the extract was performed on *C. albicans* and *C. neoformans*[26,27].

PHOTOCHEMISTRY:

Flavones and favone glycosides:

Various compounds have been isolated from the genus Rhynchosia. Among them, most of the reported C-glycosylfauns are derivatives of apigenin and luteolin.

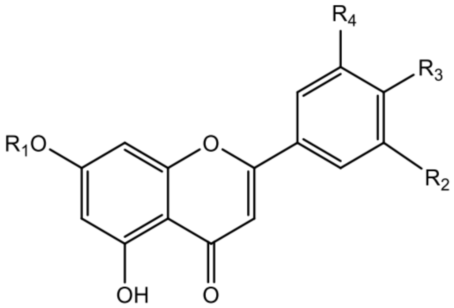

Figure 2: Basic structure of Flavones and favone glycosides compounds

Flavonols and favonol glycosides:

To date, only eight species of Rhynchosia have been recorded. All phenolics and phenolic glycosides reported in Rhynchusia seeds are kaempferol and quercetin derivatives (Figure 3). Interestingly, Linkosin, a member of the genus Linkosia, is a member of the genus *Linkosia spp*. This is the only 5-deoxyphenol from the leaves so far[23].

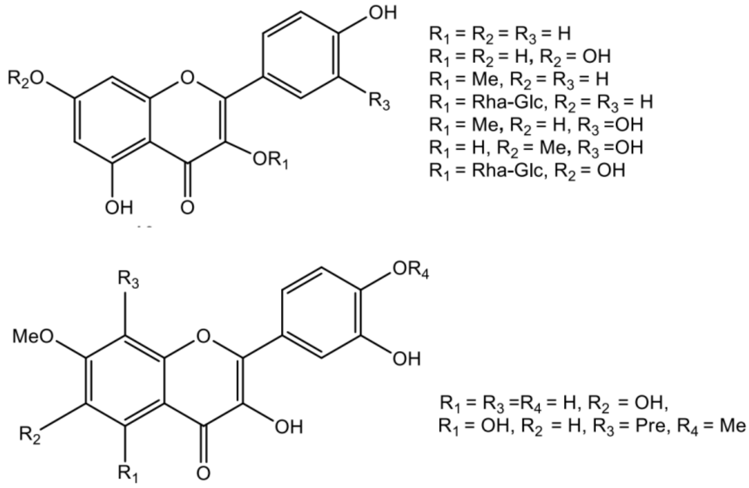

Figure 3: Flavanol and favonol glycosides isolated from the genus Rhynchosia

Flavanones:

Naringenin and lupinifolin were isolated from Rhynchosiabeddomei leaves and Rhynchosiaprecatoria roots, respectively, the only two favanones reported in this genus (Figure 4)[28].

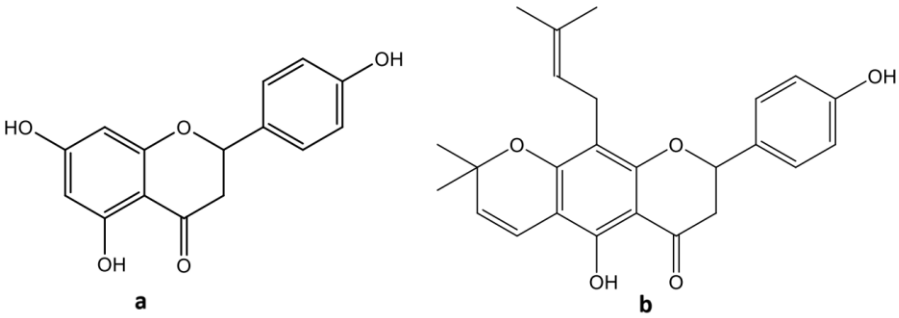

Figure 4: Flavanones isolated from the genus Rhynchosia (a and b)

Dihydrofavonols:

Only four dihydrophenols (Figure 5) have been reported in Rhynchosia seeds, and all the mentioned compounds are C-prenylated products. This compound was also reported as a new dihydrofolate from R. cyanosperma species [29].

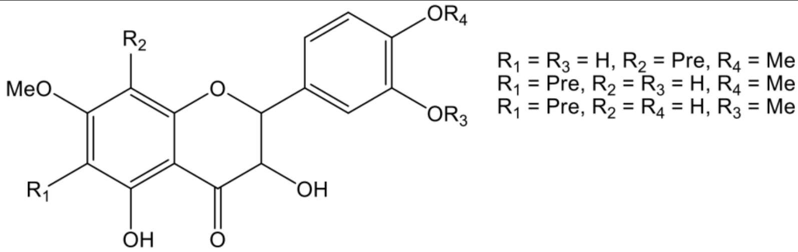

Figure 5: Dihydrofavonols isolated from the genus Rhynchosia

Isofavones and Isofavanones:

A total of 19 isophanes and 3 isoflavones were identified from Rhynchosia seeds (Figures 6 and 7). Most of the isophanes from *R. edulis* species are substituted with prenyl or dimethyl pyrano groups and do not have a B-ring preposition. In position 3, two isophanes are formed, lindolinal and sandlinal, r. not included from edulis, in addition, R.

A new method was developed for the isolation of isophanes such as biokanin A, 4'-(1"-methoxy)-propylgenistein and the ionic liquid 1-butyl-3-methyltetrafluoroborate from *Rhynchosiavolubilis*, compared with conventional methods [30]. The method of extraction and isolation of phenol using ionic liquids is an environmentally friendly and green method. Lincobicin, a new isophenoid derivative reported from viscose, with a new skeletal base attached to a benzodihydrofuran ring, was reported from 2D NMR spectral studies. Isolation of the complex was achieved using a zebrafish bioassay-based microfractionation, and this report is unique [31].

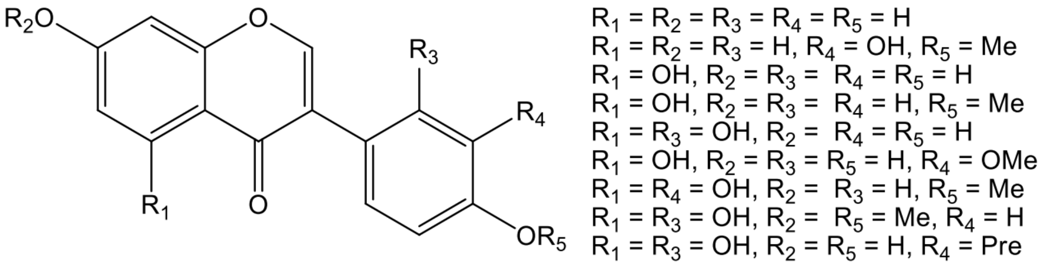

Figure 6: Isofavones isolated from the genus Rhynchosia

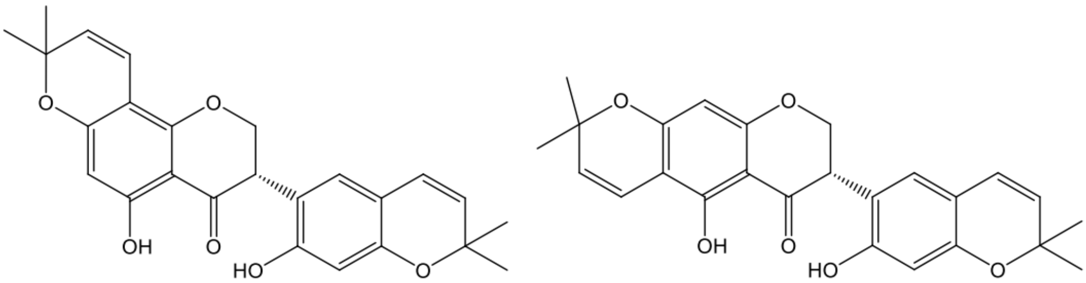

Figure 7: Isofavanones isolated from the genus Rhynchosia

Flavan-3-ols:

Catechin, epicatechin, 7-O-galloylcatechin, and proanthocyanidin are the four pavan-3-ols isolated from several Rhynchosia species so far (Figure 8)[32-34].

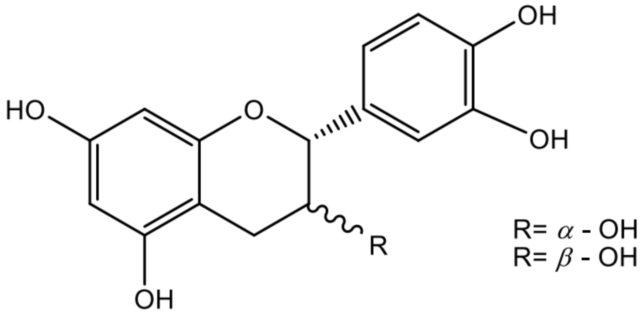

Figure 8: Flavan-3-ols isolated from the genus Rhynchosia

Other phenolic compounds:

It is a simple polyphenol compound from the non-phenolic class and is listed below.

Xanthones:

In addition to the phenoids mentioned above, two xanthone C-glycosides (Figure 9), mangiferin and isomangiferin, were isolated from *R. suvallans*. The co-occurrence of C-glycosylflavonoids and C-glycosylxanthone in *R. suvallans*is expected to be of common origin due to chemotaxonomic selection [23].

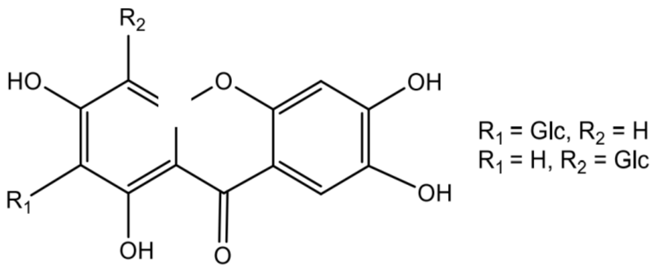

Figure 9: Xanthones isolated from the genus Rhynchosia

Biphenyls:

Two new biphenyls, 4-(3-methyl-buti-2-enyl)-5-methoxy-(1,1'-biphenyl)-3-ol and 2-carboxyl-4-(3-methyl-buti-2 - enyl)-5-methoxy-(1,1'-biphenyl)-3-ol was isolated from the whole plant of R. suaveolens (Figure 10). The presence of biphenyl in plants is thought to result from the aldol condensation of β-trichoesters derived from shimic acid[23].

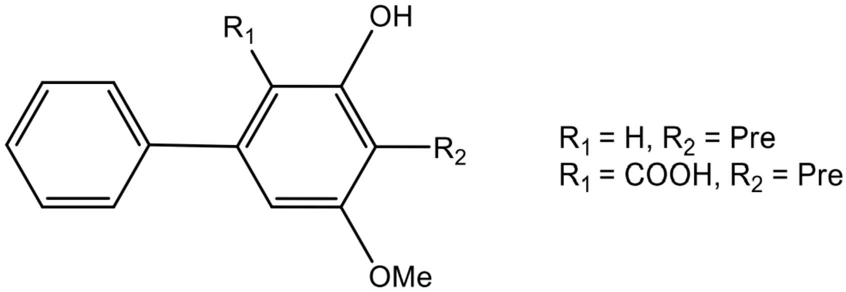

Figure 10: Biphenyls isolated from the genus Rhynchosia

Simple polyphenols:

Rhynchosia seeds have been reported to contain twelve simple polyphenol compounds consisting of gallic acid, vanillic acid, and gallic acid (Figure 11). In addition, two types of polyhydric alcohol such as D-pinetol and D-inositol were isolated from the leaves of *BedomiSundanese*. A unique trioxygenatedbenzophenone was reported as a new chemical compound from the flowers of *R. suaveolens* [23].

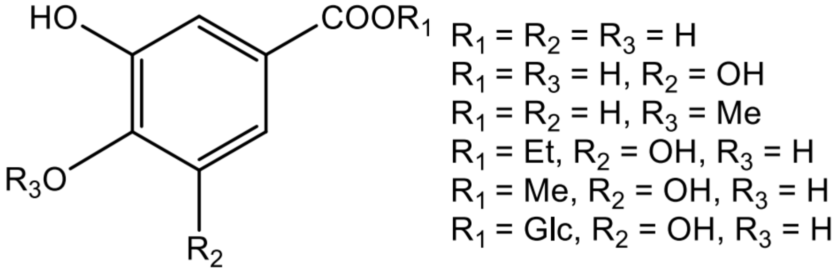

Figure 11: Simple polyphenols isolated from the genus Rhynchosia

Sterols:

β-sitosterol, stigmasterylgalactoside, lupeol and ergosterol peroxide r. Four steroid compounds have been isolated from Minima plants, including Rhynchosia seeds (Figure 12) [35].

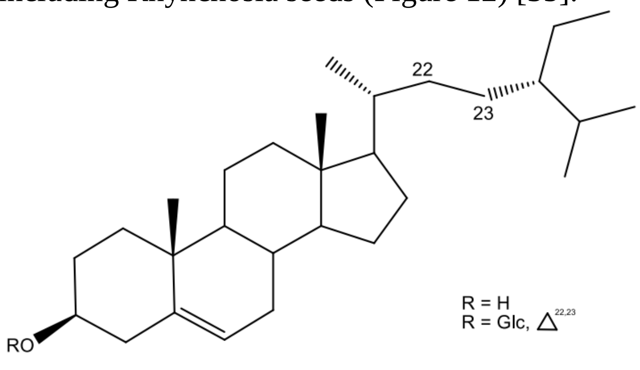

Figure 12: Sterols isolated from the genus Rhynchosia

PHARMACOLOGICAL ACTIVITIES OF GENUS RHYNCHOSIA:

Anticancer activity:

Phytochemical study of the roots of *RhynchosiaprecatoriaDC* revealed various compounds. These chemicals include: lupinfolin, lupinfolinol, cagenone, percatrin C, precatorin A and percatorin B. In addition, *Rhynchosiaprecatorii* root (except *lupinfolinol*) and isolated chemicals were tested for their potential cytotoxic effects in mouse macrophages. Cells were lysed by the MTT reduction method (RAW 264.7). Based on the IC50 value of the isolated compound (13.73 to 160.52 m), it can be concluded that this compound shows low activity. Although these compounds are not suitable for cancer therapy, they can be key molecules in the development of new synthetic molecules [23,36].

Antioxidant studies:

During metabolic processes, human tissue cells produce reactive oxygen species known as free radicals. These radicals are responsible for general oxidative damage to cells, as well as various types of cancer, inflammation, high blood pressure, and age-related diseases. Consequently, many researchers have focused their research on natural antioxidants because they act as important elements in combating oxidative damage caused by free radicals. Flavonoids are the largest class of secondary metabolites found in plants. It exhibits a variety of medicinal uses, including antioxidant properties, and is the most abundant metabolite. Isovitexin, isoauranthine, mangiferin and 2-hydroxy-3,4-dimethoxybenzophenone are four flavonoids isolated from *Rhynchosiasuvelones* flowers using bioassay. This flavonoid was then tested for 1,1-diphenyl-2-picrihydrazyl (DPPH) radical scavenging activity. Mangiferin and isorientin have significant antioxidant activity with IC50 values of 51.7 µg/ml and 57.7 µg/ml, respectively. This is compared to the antioxidant activity of neutral ascorbic acid with an IC50 value of 34.50 µg/mL [23,37].

Antimicrobial activity:

Isovitexin, isoranthine, quercetin-7-O-methyl ester, and biokanin are the names of four flavonoids that were recently identified from Rinchosia almond flowers. Each chemical was tested for antimicrobial activity against Gram-positive bacteria, Gram-negative bacteria and fungi by the disc diffusion method. *Pseudomonas aeruginosa* and *Candida albicans* were strongly inhibited by isorientin and quercetin-7-O-methyl ester, respectively. The concentration was 20.1 nM and 15.8 nM for isoorientin and 20.4 nM and 15.7 nM for quercetin-7-O-methyl ester. In addition, the results of in silico analysis and formal analysis of compounds derived from Lipinski led researchers to conclude that isortin and quercetin-7-O-methyl ester are antibacterial agents [8,38].

Antibacterial activity:

Pathogens *Bacillus subtilis* and *Staphylococcus aureus* were used to investigate the efficacy of *Rhynchosiasuaveloens* ethanol extract as an antimicrobial agent. Further purification of two biphenyl active compounds, 4-(3-methyl-buti-2-enyl)-5-methoxy-(1,1'-biphenyl)-3-ol and 2-carboxy-4, was carried out. (3-Methyl-but-2-enyl)-5-methoxy-(1,1'-biphenyl)-3-ol. When these two different biphenyls were tested against Bacillus subtilis and *Staphylococcus aureus*, the minimum inhibitory concentration (MIC) for both was 15.63 µg/mL and 31.25 µg/mL, respectively [39].

Antimycobacterial activity:

Roots of *RhynchosiaprecatoriaDC* were evaluated for in vitro bactericidal activity against Mycobacterium tuberculosis and *Mycobacterium smegmatis* using the Alamar blue redox index. In addition, the dichloromethane fraction isolated from the roots of *Rhinoceaprecatoria* yielded six phenoids: lupinofolin, lupinfolinol, cagenone, precaterin C, precaterin A, and precaterin B (Figure 13). The antifungal activity of each isolated compound except lupinfolinol was investigated. Lupinofoline and cajonone showed the highest activity against Mycobacterium tuberculosis (Mtb) with a minimum inhibitory concentration (MIC) of 31.25 and 62.5 µg/ml, respectively. Percaterin A and kagenone had a strong effect on *Mycobacterium smegmatis* (MSM), but the minimum inhibitory concentration was determined to be 125 µg/ml (297.29 µM) and 125 µg/ml (295.87 µM), respectively[8,36].

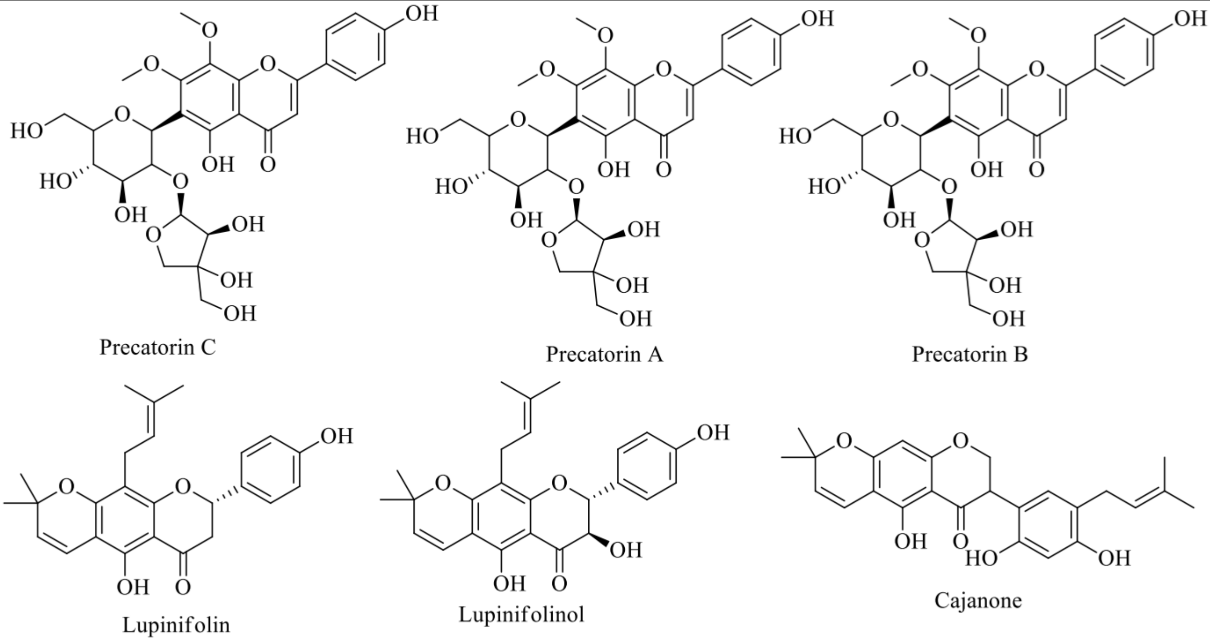

Figure 13: The structures of phytoconstituents reported as antimycobacterials isolated from Rhynchosiaprecatoria

Antityrosinase activity:

Bioassay-based isolation of *Rhynchosiavillosa* root produced five different chemical compounds. These compounds include genistein, 2'-hydroxygenistein, kagenin, catechin, and 7-azlocatechin. In addition, the extracted compound has tyrosinase activity. These included genistein (31.45 µM), catechin (36.86 µM), cajanin (38.97 µM), gallocatechin (60.40 µM), and 2'-hydroxygenistein (69.49 µM). Genistein and casein show the strongest tyrosinase inhibitory activity, suggesting that they can be used as whitening agents in the treatment of hyperpigmentation [8,23,40].

Anti-inflammatory and anti-angiogenic activities:

Five flavonoid compounds were found in the paper combining microforms of *Rhynchosia viscose* from zebrafish. These compounds include genistein, 3'-O methylrubol, licoflavoneA, sophorisoflavone A, and the newer chemical lincovisin (Figure 14). Then, the isolated compounds were subjected to LPS-stimulated leukocyte migration assays to determine whether they have anti-inflammatory properties. Genistein and sophorisophon A showed significant ability to inhibit leukocyte migration with IC50 values of 12.5 µM and 25 µM, respectively. One of the other two 3'-O-methylarobols, lycosophage A, showed no inhibition. In addition, we tested the angiogenic activity of the extracts and compounds using a zebrafish-based vessel development assay. The anti-angiogenic properties of genistein and lycophagan A have good potential with IC50 values of 24.50 mM and 16.7 µM, respectively [8,23,31].

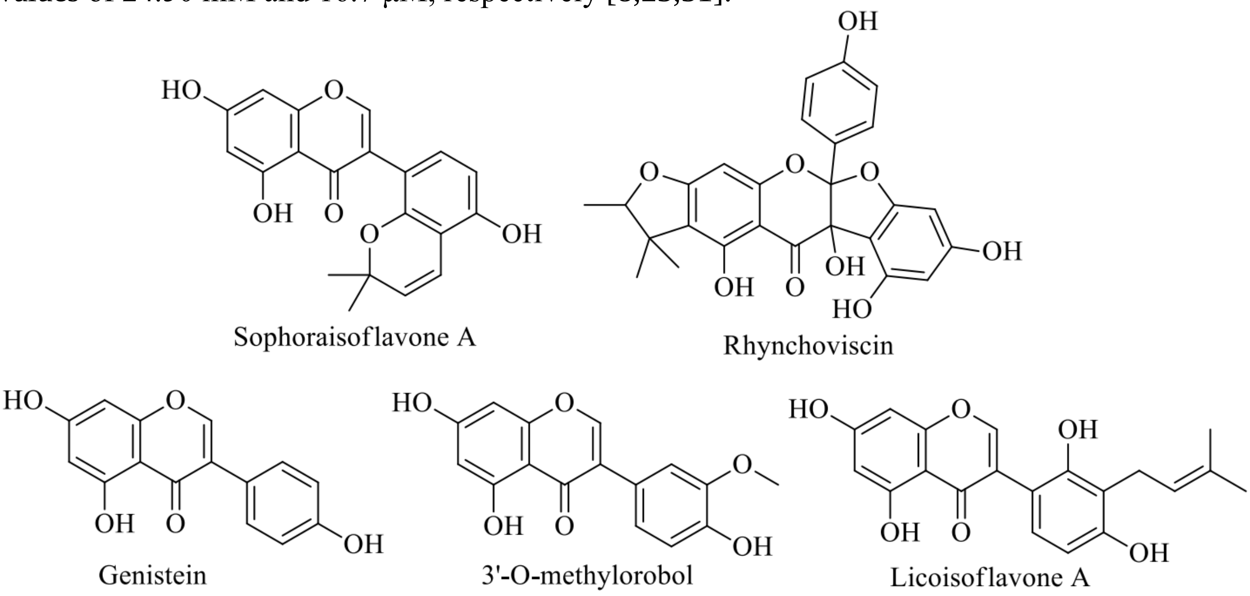

Figure 14: The structures of phytoconstituents reported as anti-inflammatory isolated from Rhynchosia.

CONCLUSION:

Lincosia species are widespread throughout the world in tropical and subtropical regions. This review summarizes the traditional uses, isolated compounds and medicinal properties of Rinchosia species. Various compounds have been isolated from the genus Rinchosia, including phenoloids, isoflavonoids, faban-3-ols, xanthones, biphenyls, simple polyphenols and sterols. Some medicinal properties include: antibacterial activity, allopathic activity, angiogenic activity, anti-inflammatory activity, antifungal activity, antioxidant activity, anti-proliferative activity, anti-tyrosinase activity and cytotoxic activity. It seems that there is not enough research on this breed. In conclusion, we anticipate that further research on Linkosia species will lead to the discovery of new natural chemicals that exhibit strong biological activity.

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