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An Overview of Pharmacological Potential of the genus *Rhynchosia*

Sharad D. Tayade[1,2]*, Narendra Silawat[1]

[1*]Faculty of Pharmacy, Oriental University, Indore, Madhya Pradesh, India-453555;

[2]Rajarshi Shahu College of Pharmacy, Buldhana, Maharashtra, India-443001.

***Corresponding Author Email ID:** sharad_tayade1@rediffmail.com*

Abstract:

Historically speaking, medicinal plants have always played an important part in human existence, and this trend dates back to ancient times. Natural compounds are now the most important source for contemporary drug development. This is due to the fact that natural compounds have the highest therapeutic selectivity, the fewest possible adverse effects, an affordable source, and may serve as lead molecules for the identification of novel medications. There is a widespread distribution of *Rhynchosia* species, which belong to the family *Fabaceae*, across the world's tropical and subtropical regions. Some of the plants in this genus have a history of use in traditional medicine for the treatment of a variety of conditions, including those requiring an antibacterial agent, an anti-diabetic agent, an abortifacient, a wound healer, a hepatoprotective agent, or a remedy for boils, rheumatic pains, or skin infections. In this review, traditional applications of *Rhynchosia* species, and pharmacological activity of *Rhynchosia* species are compiled. It was noticed that, not enough research has been done on this genus; as a consequence, we have predicted that additional research on Rhynchosia species will likely lead to the discovery of new natural chemicals that exhibit powerful biological activity. As a result, this study could be able to provide a bird's eye view of the future experimental research that will be carried out in the hunt for innovative drugs.

Keywords: Pharmacological activity; Genus; Traditional uses; Herbal medicines

1. Introduction

The term "traditional medicine" refers to "the knowledge, skills, and practices based on the theories, beliefs, and experiences indigenous to different cultures, used in the maintenance of health and in the prevention, diagnosis, improvement, or treatment of physical and mental illness"[1,2]. A holistic approach to life, equilibrium of the mind, body, and environment, and an emphasis on health rather than on disease are all common tenets of traditional medicine, which can be found in a variety of different forms and have developed independently in different parts of the world at different times[3,4]. Traditional medical practices and philosophies are influenced by the conditions, environment, and geographical region in which they were developed for the first time. Traditional medical practices center not on the specific illness or disease that a patient is suffering from, but rather on the state of the person as a whole, and the use of herbs is an essential component of all of these practices[5,6].

Traditional medicine is used for a variety of reasons, the most common of which are that it is less expensive, that it more closely corresponds to the patient's ideology, that it allays concerns about the adverse effects of chemical (synthetic) medicines, that it satisfies a desire for more personalized health care, and that it allows the public greater access to health information[7,8]. The most common use for herbal medications are health maintenance and treatment of ongoing problems, as opposed to emergency situations or acute illnesses. On the other hand, when contemporary medicine is unable to effectively treat a sickness, such as when cancer has reached an advanced stage or when there is a newly emerging infectious disease, people are more likely to turn to traditional treatments. In addition, people have a general perception that traditional medicines are natural and harmless, or in other words, not poisonous. This is not always the case, particularly when herbs are used in conjunction with prescription pharmaceuticals, over-the-counter treatments, or even other herbs, as is very often the case[9–11].

Herbs and plants can be processed in a variety of ways and taken in a variety of forms, some of which include the whole herb, teas, syrup, essential oils, ointments, salves, rubs, capsules, and tablets that contain a ground or powdered form of a raw herb or its dried extract. Plants and herbs can be extracted using a variety of solvents, temperatures, and times[12]. These

include alcoholic extracts (tinctures), vinegars (acetic acid extracts), hot water extract (tisanes), long-term boiled extract, typically roots or bark (decoctions), and cold infusion of plants. The solvent used for extraction can vary (macerates). Because there is no standardization, the components of a herbal extract or a product are likely to vary quite a little from one batch to the next and from one manufacturer to another[13].

2. Genus *Rhynchosia*

Rhynchosia species have played an important part in the historical use of plants belonging to the *Fabaceae* family in the field of traditional medicine. Out of the roughly 300 species that make up the *Rhynchosia* genus that may be found in tropical and subtropical regions all over the globe, India is home to twenty-two of those species[14,15]. Herbs, twining shrubs, and upright shrubs may be found among the species that belong to the genus *Rhynchosia* in the family *Fabaceae*. The *Rhynchosia* genus is the only one known to produce C-glycosylfavonoids in significant quantities, as shown by earlier phytochemical research conducted on many members of the genus[16]. Antioxidant, anti-inflammatory, antimycobacterial, and antiproliferative are only some of the fascinating biological actions shown by isolated chemicals and plant extracts from the *Rhynchosia* genus[17]. The purpose of this study was to provide an overview of the many traditional applications and pharmacological activity associated with the genus *Rhynchosia*.

2.1 Traditional uses

There are a few plants in the *Rhynchosia* genus that have been used in indigenous medicine by Adivasi tribes for a variety of purposes, including as an antibiotic, an anti-diabetic, an abortifacient, the healing of wounds, a hepatoprotective, a remedy for rheumatic pains, and a treatment for boils and skin infections[18–20]. These uses are based on folkloric medications. For instance, the plant *Rhynchosia scarabaeods* L., often referred to as ‘gadi chikkudu kaya’, has been utilized to cure a variety of bacterial ailments, including dysentery, diarrhea, and skin infections. In Pakistan, the *Rhynchosia pseudo-cajan* Cambess plant in its entirety is utilized as a treatment for oxidative stress using antioxidant principles[21]. This plant is extensively dispersed across the country. There are several species of the *Rhynchosia* genus, each of which has roots that contain bacterial nodules. These nodules improve the soil and may be valuable for

agricultural techniques. Some members of the genus *Rhynchosia* are claimed to have pharmacological characteristics that are bitter and toxic, although the seeds of these plants are occasionally used as analgesics by indigenous communities in South Mexico[22].

2.2 Reported pharmacological activities

2.2.1 Antioxidant activity

During the process of metabolism, the cells of human tissue produce reactive oxygen species known as free radicals. These radicals are responsible for the general oxidative damage that leads to cellular damage, as well as numerous forms of cancer, inflammation, hypertension, and age-related disorders. As a result, a significant number of researchers have concentrated their efforts on natural antioxidants since these compounds serve as fundamental elements in the fight against oxidative damage caused by free radicals. Flavonoids make up the largest category of secondary metabolites that can be found in plants. They exhibit a diverse array of medicinal uses, including antioxidant properties, and are the most abundant of these metabolites. Isovitexin, isoorientin, mangiferin, and 2-hydroxy-3,4-dimethoxybenzophenone (Figure 1) were the four flavonoids that were isolated from the flowers of *Rhynchosia suaveloens* using a bioassay as a guide. These flavonoids were then put through tests to determine whether or not they had 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging activity. Mangiferin and isoorientin had significant antioxidant activity, with IC_{50} values of 51.7 and 57.7 µg/mL, respectively. This was in comparison to the antioxidant activity of the positive control ascorbic acid, which had an IC_{50} value of 34.2 µg/mL[22].

In a different scientific paper, the aerial parts of *Rhynchosia capitata* were investigated using DPPH and nitric oxide antioxidant principles. This investigation led to the discovery of five different C-glycosylfavanoids, which were referred to as vitexin, isovitexin, vicenin 2, orientin, and isoorientin (Figure 1). Through the use of density functional theory (DFT), the C-glycosyl favonoids were investigated in order to get an understanding of the molecular features, variables, and mechanisms involved in their radical scavenging capabilities. According to the findings of this research, the antioxidant activity of C-glycosyl favonoids is shown not by scavenging for and neutralizing free radicals but rather by donating electrons. As a consequence

of this, the authors of this paper reach the conclusion that the compound vitexin functions as an effective radical scavenger on the basis of quantum chemical computation and theoretical investigation[23].

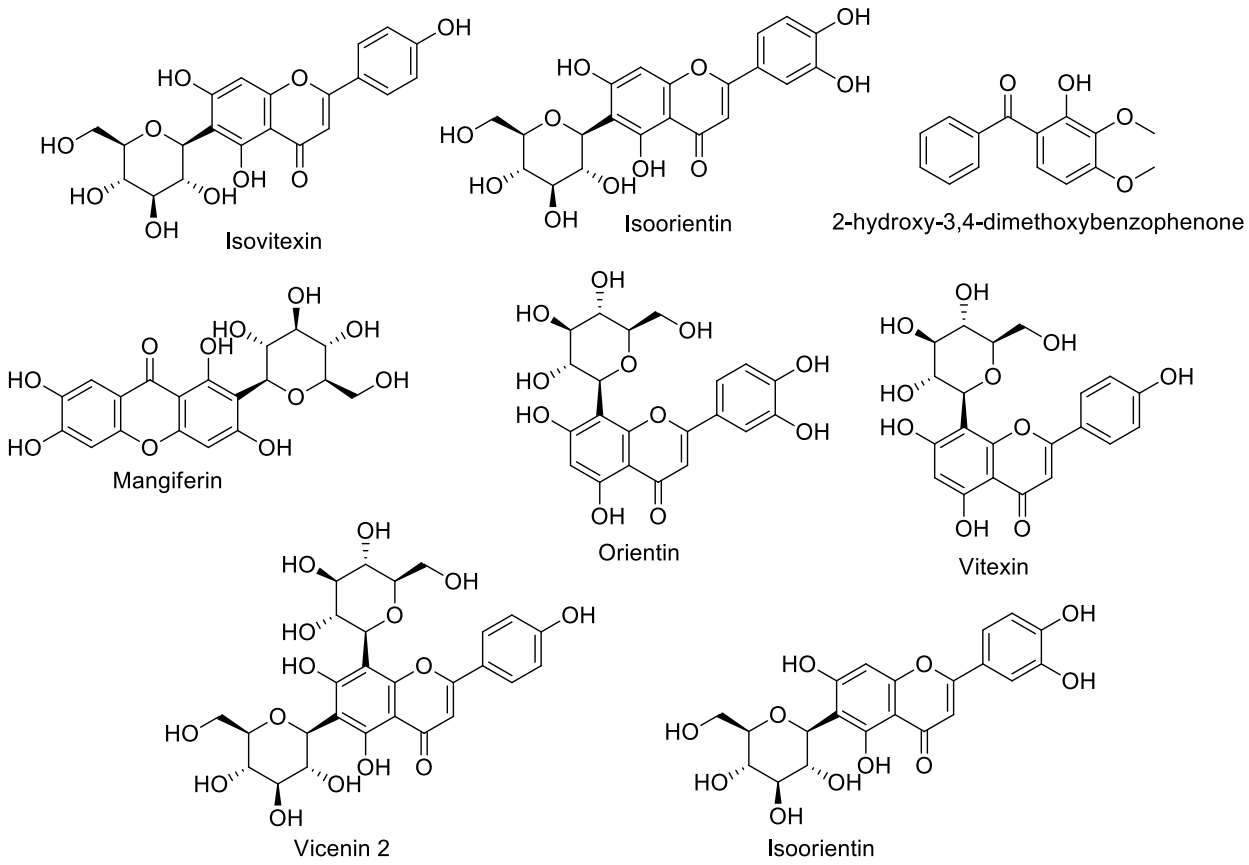

Figure 1. The structures of phytoconstituents reported as antioxidants isolated from *Rhynchosia suaveloens* and *Rhynchosia capitata*

2.2.2 Antimicrobial activity

Isovitexin, isoorientin, quercetin-7-O-methylether, and biochanin A are the names of the four flavonoids that were recently identified from the flowers of *Rhynchosia beddomei*. Using the disc diffusion technique, each chemical was examined to see whether or not it has any antibacterial activity against gram-positive and gram-negative bacteria as well as fungi. Both *Pseudomonas aeruginosa* and *Candida albicans* were inhibited at potent quantities by isoorientin and quercetin-7-O-methylether, respectively. The concentrations were 20.1 nm and 15.8 nm for isoorientin, and 20.4 nm and 15.7 nm for quercetin-7-O-methylether. In addition, the results of

the *in silico* and Lipinski's rule analyses of the compounds that were extracted led researchers to the conclusion that isoorientin and quercetin-7-O-methylether are effective antibacterial agents[24].

2.2.3 Antimycobacterial activity

The roots of *Rhynchosia precatoria* DC were evaluated with the redox indicator Alamar Blue for *in vitro* inhibitory and bactericidal activities against *Mycobacterium* TB and *Mycobacterium smegmatis*. In addition, the dichloromethane fraction of the roots of *Rhynchosia precatoria* was subjected to isolation, which resulted in the production of six favonoids: lupinifolin, lupinifolinol, cajanone, precatorin C, precatorin A, and precatorin B (Figure 2). The antimycobacterial activity of each of the isolated compounds, with the exception of lupinifolinol, was investigated. With a minimum inhibitory concentration (MIC) of 31.25 and 62.5 µg/mL, respectively, the substances lupinifolin and cajanone shown the highest level of action against *Mycobacterium tuberculosis* (Mtb). While the substances precatorin A and cajanone demonstrated strong action against *Mycobacterium smegmatis* (Msm), their minimal inhibitory concentrations were set at 125 µg/mL (297.29 µM) and 125 µg/mL (295.87 µM), respectively[16].

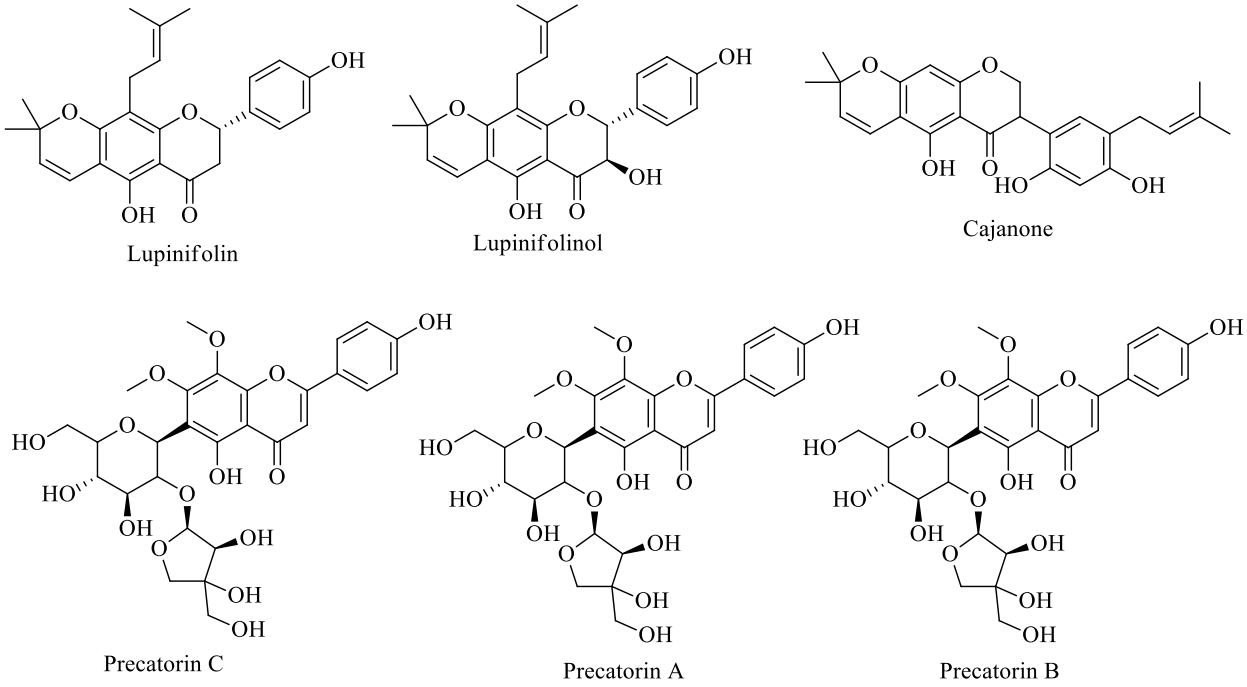

Figure 2. The structures of phytoconstituents reported as antimycobacterials isolated from *Rhynchosia precatoria*

2.2.4 Anti-inflammatory and anti-angiogenic activities

A recent publication on the Zebrafish integrated micro fractionation of *Rhynchosia viscosa* led in the discovery of five flavonoid compounds. These compounds include genistein, 3′-O-methylorobol, licoisoflavone A, sophoraisoflavone A, and Rhynchoviscin (Figure 3), a completely new chemical. In addition, the isolated compounds were put through an LPS-enhanced leukocyte migration experiment to determine whether or not they have anti-inflammatory properties. Both genistein and sophoraisofavone A shown a considerable ability to suppress leukocyte migration, with an IC_{50} value of 12.5 and 25 µM, respectively. Licoisofavone A, one of the other two 3′-O-methylorobols, did not demonstrate any substantial inhibition. Additionally, a Zebrafish-based vascular outgrowth assay was used to test the angiogenic activity of the extracts and compounds. The anti-angiogenic properties of the substances genistein and licoisofavone A were shown to have a good potency, with IC_{50} values of 24.2 and 16.7 µM, respectively[25].

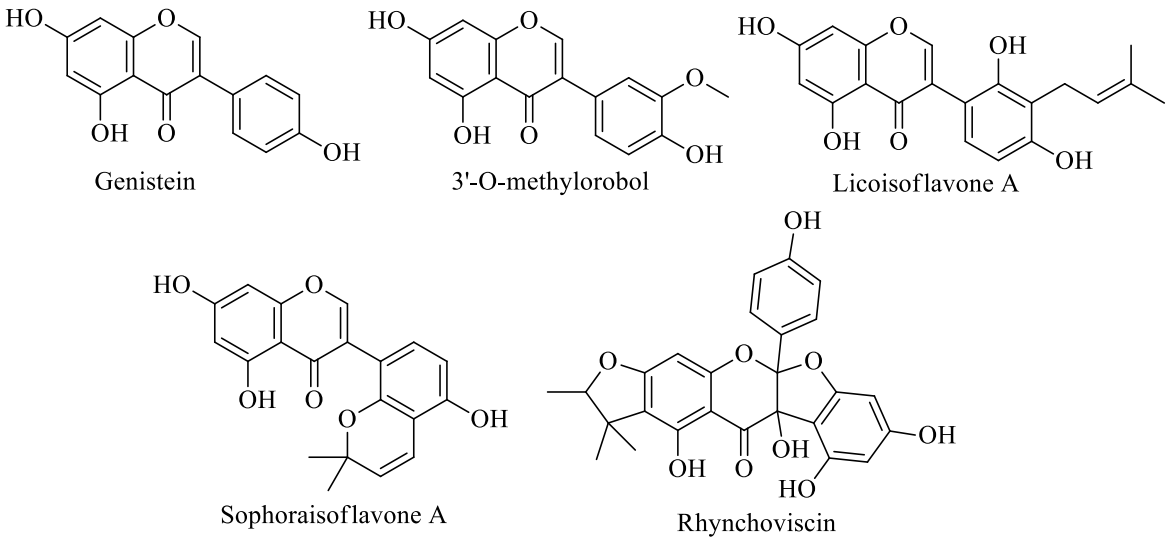

Figure 3. The structures of phytoconstituents reported as anti-inflammatory isolated from *Rhynchosia viscosa*

2.2.5 Antityrosinase activity

The bioassay-guided isolation of *Rhynchosia villosa* roots led in the discovery of five different chemicals. These compounds include genistein, 2′-hydroxygenistein, cajanin, catechin, and 7-O-galloylcatechin. In addition, the compounds that were extracted had significant tyrosinase activity. These included genistein (at 31.45 µM), catechin (at 36.86 µM), cajanin (at 38.97 µM), galloylcatechin (at 60.40 µM), and 2′-hydroxygenistein (at 69.49 µM). The genistein and cajanin showed the strongest tyrosinase inhibitory activity, which indicates that they have the potential to be employed as a depigmenting agent in the treatment of hyperpigmentation[25].

2.2.6 Anticancer activity

Six different compounds were discovered as a result of a phytochemical study conducted on the roots of *Rhynchosia precatoria* DC. These chemicals include lupinifolin, lupinifolinol, cajanone, precatorin C, precatorin A, and precatorin B. In addition, the roots of Rhynchosia precatoria as well as its separated chemicals (with the exception of lupinifolinol) were tested for their potential cytotoxic action against murine macrophage cells (RAW 264.7) using an MTT reduction assay. Based on the IC_{50} values of the isolated compounds, which ranged from 13.73 to 160.52 µM, it can be deduced that these compounds display less prominent activities. Although they may not be suitable for the treatment of cancer disease, these compounds could serve as lead molecules in the development of new synthetic molecules[16].

2.2.7 Antibacterial activity

Pathogens *Bacillus subtilis* and *Staphylococcus aureus* were used in the research that investigated the efficacy of an ethanol extract of the entire plant of *Rhynchosia suaveloens* as an antibacterial agent. Additional purification of the active fraction results in the production of two biphenyls: 4-(3-methyl-but-2-enyl)-5-methoxy-(1,1′-biphenyl)-3-ol (60) and 2-carboxy-4-(3-methyl-but-2-enyl)-5-methoxy-(1,1′-biphenyl)-3-ol (61). These two different biphenyls, when tested against *Bacillus subtilis* and *Staphylococcus aureus*, both demonstrated activity with a minimum inhibitory concentration (MIC) of 15.63 and 31.25 µg/mL, respectively[26].

Conclusion

Though approximately 300 *Rhynchosia* species are distributed all over the world, only 22 species, *R. bracteata, R. beddomei, R. cana, R. capitate, R. cyanosperma, R. densifora, R. edulis, R. heynei, R. jacobii, R. minima, R. precatoria, R. pyramidalis, R. pseudo-cajan, R. rothii, R. rufescens, R. sericea, R. suaveolens, R. sublobata, R. scarabaeoides, R. villosa, R. viscosa and R. volubilis*, have been investigated so far. Most of the reported activities are antibacterial, allelopathic activity, anti-angiogenic activity, anti-inflammatory activity, antimycobacterial, antioxidant, antiproliferative, antityrosinase and cytotoxic activity. It was observed that, not enough research has been done on this genus; as a consequence, we have predicted that more research on *Rhynchosia* species will likely lead to the discovery of new natural chemicals that exhibit powerful biological activity. This study may thus provide a bird's eye perspective for the future experimental research that will be conducted in the search for novel medications.

Conflict of Interest

Authors declared that there are no conflicts of interest exists.

Acknowledgement

None

Competing Interests

Authors have declared that no competing interests exist

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