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FROM GARDENS TO LABORATORIES: A CONTEMPORARY APPRAISAL OF BELAMCANDA CHINENSIS IN MEDICINE WITH EMPHASIS ON ANTICANCER AND ANTITUMOUR PROPERTIES

***Arshu Patel and Komal Kate**

India.

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***Corresponding Author**
Arshu Patel
India.

ABSTRACT

For more than 2000 years, belaamcanda chinensis—also referred to as leopard lily or blackberry lily—has been an essential component of Chinese traditional medicine. This thorough analysis examines its historic use, botanical traits, and prospective medicinal benefits. The plant's rhizome has long been used to treat respiratory conditions, and current studies have shown that it may effectively control hyperglycemia, suggesting that it may also be useful in the treatment of diabetes. The therapeutic effects of the plant are attributed to its bioactive constituents, which include luteolin, kaempferol, isorhamnetin, quercetin, and tectorigenin. The research reveals encouraging results on the antitumor and anticancer properties of Belamcanda chinensis. Specifically, ethyl acetate extracts have noteworthy effects against many cancer cell lines. The plant is a botanical treasure in a variety of cultural contexts due to its wide geographic distribution, versatility, and aesthetic appeal. The study also covers indigenous uses, such as decorative landscaping, anti-inflammatory use, and perhaps symbolic meaning. The plant's attractiveness is increased by phenotypic traits including vivid blooms and unusual seed capsules. We look closely at the chemical components and pharmacological actions, which include antidiabetic, wound-healing, antioxidant, and anti-inflammatory effects. The study emphasizes the need for more investigation to find new active compounds, comprehend synergistic effects, and fill up toxicity and pharmacokinetic gaps. All things considered, Belamcanda chinensis has great promise as an adjunctive therapy option because of its extensive historical background and current scientific discoveries, which will facilitate further study and the creation of potent medicinal compounds.

KEYWORDS: Belamcanda chinensis, Traditional Chinese Medicine, Rhizome, Bioactive Compounds, Antioxidant, Anti-inflammatory, Antitumor, Anticancer, Diabetes Management, Indigenous Applications.

INTRODUCTION

For many generations, Chinese traditional medicine has utilized the dried rhizome of Belamcanda Chinensis (L.), a member of the Iridaceae family, to cure throat ailments and inflammation. In both healthy and streptozotocin (STZ) chemical compound-induced rats with diabetes, the aqueous extract from Belamcanda chinensis leaves has shown remarkable effectiveness in regulating hyperglycemia.[1] This impact is explained by its capacity to increase insulin secretion via a mechanism that depends on K+-ATP channels. These results imply that belamcanda chinensis has potential for treating diabetes and its related problems. Belamcandae chinensis rhizoma is the traditional cure that has gained reputation for its therapeutic properties, especially in the treatment of respiratory problems. Its continued use in traditional Chinese medicine emphasizes how important it is as a historically significant medication, particularly for its effectiveness in treating a range of respiratory conditions.[2,3] To explore the potential medicinal uses of this plant, more research is needed to determine how different extracts made from Belamcanda chinensis leaf affect blood sugar levels in KK-Ay mice. For millennia, the dried-out rhizome of Belamcanda chinensis, known as "Shegan" in Chinese, served as an essential component of traditional Chinese medicine. It has been used historically to treat respiratory ailments such pharyngitis, asthma, and lung problems.[4] Belamcandae chinensis rhizoma is the traditional cure that has gained reputation for its therapeutic properties, especially in the treatment of respiratory problems. Its continued use in traditional Chinese medicine emphasizes how important it is as a historically significant medication, particularly for its effectiveness in treating a range of respiratory conditions. There are many bioactive components associated with the Shen Nong Ben Cao Jing, which is also referred to as butterfly bloom and flat bamboo.[5,6] The most common ones include tectoridin, tectorigenin, iridin, irigenin, and irisflorentin. These components, which are present in different parts of Belamcanda chinensis, contribute to the medicinal properties of the plant. Notably, a variety of factors can impact the composition of herbal medicines, such as plant species, organ specificity, developmental phases, growth environments, harvesting times, and processing and storage conditions. Through comprehensive phytochemical screening, more than 100 chemical constituents from various areas of B. chinensis have been successfully discovered. Furthermore, a great deal of study has been done on B. chinensis to

profile the expression patterns in several organs and to pinpoint the essential genes for the synthesis of (iso)flavonoids.[7] One of the first pharmacopoeias of traditional Chinese medicine, Divine Farmer's Herb-Root Classic, is where the rhizome of B. chinensis was originally mentioned. It cleared lung dust, soothed the throat, cleared congestion, and lessened pain and swelling, among other benefits. In traditional Chinese medicine, it is mostly used to treat inflammation of the respiratory tract, asthma, obstruction of the throat, carbuncles, painful poison, etc.[8]

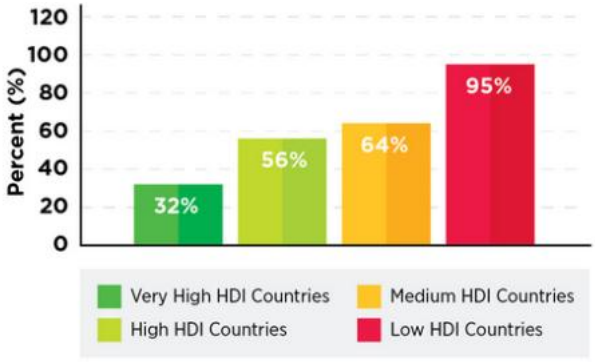

Fig: Increase in estimated new cancer cases between 2018-2023.

Using a variety of medicinal plants and their derivatives to treat a wide range of ailments has become standard practice in today's medical environment. The use of Chinese herbal remedies, which have a centuries-long history of medicinal use, is one notable tradition in this respect. Native to China, this plant grows especially well in Guizhou, Yunnan, and Sichuan provinces. Notably, the Chinese Pharmacopoeia (2005) recognized it as an official drug. In traditional medicine, the rhizome of Borrelia chinensis has a long and distinguished history that dates back more than two millennia.[9] It has been used to treat a wide range of illnesses, including cancer, pulmonary disorders, acute and chronic pharyngitis, and asthma. In addition to its traditional medical use, B. chinensis has attracted notice for its antioxidant qualities, which are mainly ascribed to the isoflavones that are extracted from the plant.[10] The medicinal potential of B. chinensis has been studied recently, with an emphasis on its rhizomes. Interesting results were obtained by extraction utilizing several solvents; ethyl acetate extracts showed strong anticancer activity against PC3, Bcap-37, and BGC-823 cell lines. Additionally, these extracts showed a modest ability to scavenge the free radical 1,1-diphenyl-2-picrylhydrazyl (DPPH). These findings emphasize the potential of ethyl acetate extracts as a useful tool in the ongoing search for efficient cancer therapies and highlight the prospective anticancer effects of B. chinensis.[11]

Indigenous applications

Belamcanda chinensis, also referred to as leopard lily or blackberry lily, has a variety of native uses that are ingrained in customs. This plant's rhizomes are commonly used for traditional medical preparations due to its alleged anti-inflammatory effects. These rhizomes can be used to make decoctions and infusions that may have medicinal use for treating particular conditions. Beyond its use in medicine, Belamcanda chinensis is an attractive plant with eye-catching blossoms that enhances gardens and landscapes. Because of its aesthetic value, it is frequently used in landscaping, adding to the rich visual diversity of many cultural contexts. Furthermore, the plant could be symbolic in some ceremonies and rituals, indicating how it has been incorporated into cultural activities. Certain sections of Belamcanda chinensis may be used in various traditional cuisines, however due to possible variances in edibility, caution must be exercised. To add to the plant's many indigenous uses, its parts, such seeds, may also have been used historically for crafts or dyeing.[12,13] Beyond practical applications, Belamcanda chinensis could be entwined with cultural tales and mythology, adding to its relevance in a variety of groups. Understanding the complex and multifaceted nature of these uses is essential if one is to recognize the plant's significance in traditional medicine as well as in its cultural, decorative, and symbolic aspects. The understanding of Belamcanda chinensis and its possible uses is evolving because of scientific investigation, highlighting the significance of careful and educated use in accordance with scientific and cultural knowledge.[13]

Phenotypic Characteristics

Belamcanda chinensis, sometimes called the leopard lily or blackberry lily, is a famous botanical treasure that combines aesthetic appeal with intriguing botanical characteristics. This plant is distinguished by its eye-catching and colorful blossoms, with each petal featuring a distinct combination of bright orange tones and stunning black dots, evoking the complex patterns seen on a leopard's coat.[14] The plant's unique appeal in gardens and landscapes is enhanced by these flowers, which also provide a visual spectacle. Belamcanda chinensis has an attractive and erect appearance when it reaches its normal height of 2 to 3 feet (60 to 90 cm) in the botanical world.[15] Furthermore, the plant could be symbolic in some ceremonies and rituals, indicating how it has been incorporated into cultural activities. Certain sections of Belamcanda chinensis may be used in various traditional cuisines, however due to possible variances in edibility, caution must be exercised. To add to the plant's many indigenous uses, its parts, such seeds, may also have been used historically for

crafts or dyeing. Beyond practical applications, Belamcanda chinensis could be entwined with cultural tales and mythology, adding to its relevance in a variety of groups.[15,16] Understanding the complex and multifaceted nature of these uses is essential if one is to recognize the plant's significance in traditional medicine as well as in its cultural, decorative, and symbolic aspects. This attractive perennial is hardy and will grow in a variety of climates and soil types. Because of its toughness, gardeners and landscapers who are looking for a plant that can handle the difficulties posed by various environmental situations in addition to being aesthetically pleasing, highly value it.

Geographical Spread

Being indigenous to parts of Asia, such as China, Japan, and Korea, Belamcanda chinensis has a wide geographic distribution. It has been grown and allowed to naturalize in many locations throughout the world outside of its original environment. The plant's capacity to adapt to many conditions has made it easier for it to be introduced to temperate countries like North America and Europe. It contributes to the diversity of flowers in both urban and rural environments when grown and found in gardens and landscapes.[17]

Chemical Constituents

Flavonoid

1. **Quercetin:** Belamcanda chinensis is one of the many fruits, vegetables, and plants that contain quercetin, a well-known flavonoid. Strong antioxidant quercetin promotes cellular health and lowers oxidative stress by assisting the body in combating free radicals. Studies looking into its ability to reduce inflammatory conditions are interested in it because of its anti-inflammatory qualities. Additionally known for enhancing immunity, quercetin helps the body's defenses against diseases and infections.[18]
2. **Kaempferol:** Another important flavonoid present in Belamcanda chinensis that may contribute to the plant's possible health advantages is kaempferol. Kaempferol, like quercetin, is well-known for its antioxidant qualities, which help shield cells from oxidative harm. Research has indicated that kaempferol could have anti-cancer properties by affecting several cellular functions. Its possible significance in moderating inflammation-related illnesses is further attributed to its anti-inflammatory characteristics. Due to its diverse range of actions, kaempferol is an important substance when it comes to plant-based therapy.[19]

3. **Isorhamnetin:** Many plants, such as Belamcanda chinensis, contain isorhamnetin, which is known for its anti-inflammatory and antioxidant qualities. Studies have investigated its possible advantages in shielding cells from inflammation and oxidative damage. Isorhamnetin is a flavonoid that supports the plant's defensive systems and, when applied or taken in the right circumstances, may have positive benefits on health.[20]
4. **Luteolin:** Luteolin has being investigated for possible neuroprotective benefits in addition to its well-known anti-inflammatory qualities. Lutein, which is present in several plants, such as Belamcanda chinensis, may be involved in controlling the body's inflammatory reactions. Given its neuroprotective properties, it could help maintain cognitive health. The presence of luteolin in Belamcanda chinensis, like that of other flavonoids, increases the plant's potential medicinal usefulness.[21]
5. **Tectorigenin**: One kind of flavonoid, a class of substances present in plants, is tectorigenin. Flavonoids have been studied for their possible health advantages, including anti-cancer effects, and are well-known for their antioxidant qualities. According to certain research, tectorigenin may possess anti-cancer capabilities via a few different pathways. Tectorigenin, for instance, has been shown to have anti-proliferative effects on cancer cells, which suggests that it may prevent the cancer cells from proliferating and dividing quickly.[22] Tectorigenin has also been studied for its ability to cause apoptosis, a process of prearranged cell death. The body uses apoptosis as a natural method to get rid of damaged or abnormal cells. Therefore, it is desired for prospective anti-cancer drugs to be able to cause apoptosis in cancer cells. Tectorigenin's anti-inflammatory and anti-angiogenic qualities have also been researched. Anti-inflammatory and anti-angiogenic drugs are of interest in cancer research because they can inhibit the processes that lead to the growth and spread of cancer: inflammation and the angiogenesis (the production of new blood vessels).[23,24]

Pharmacological activities

Table: Pharmacological Activity, Bioactive Compounds, and Potential Effects of Belamcanda chinensis.

Pharmacological Activity	Bioactive Compounds	Potential Effects
Antioxidant Activity[35]	Quercetin, Kaempferol, Isorhamnetin, Luteolin	Neutralizing free radicals, protecting cells from oxidative stress
Anti-Inflammatory Effects[36]	Quercetin, Luteolin	Modulating inflammatory responses, potential benefit in chronic inflammation
Immunomodulatory Properties[37]	-	Traditional use suggests immune-boosting effects

Neuroprotective Potential[39]	Luteolin	Supporting cognitive health, potential protection against neurodegenerative conditions
Anticancer Activity[40]	Kaempferol Tectorigenin	Associated with potential anticancer effects.
Antimicrobial Effects[40]	-	Potential antimicrobial properties, traditional use in addressing infections.
Anti-diabetic Properties[41]	-	Some compounds may have anti-diabetic properties.
Wound Healing[42]	-	Traditional uses suggest potential for aiding in the healing process, possibly through anti-inflammatory and antioxidant effects

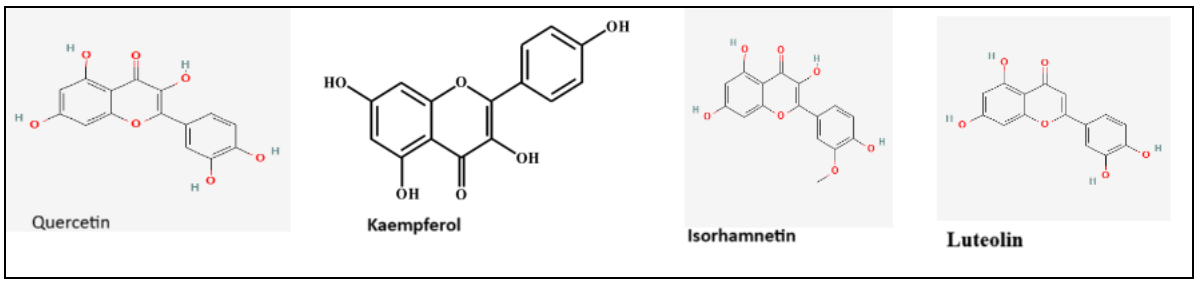

Fig. Structure of Bioactive compound- quercetin, Kaempferol, Isorhamnetin, Luteolin.

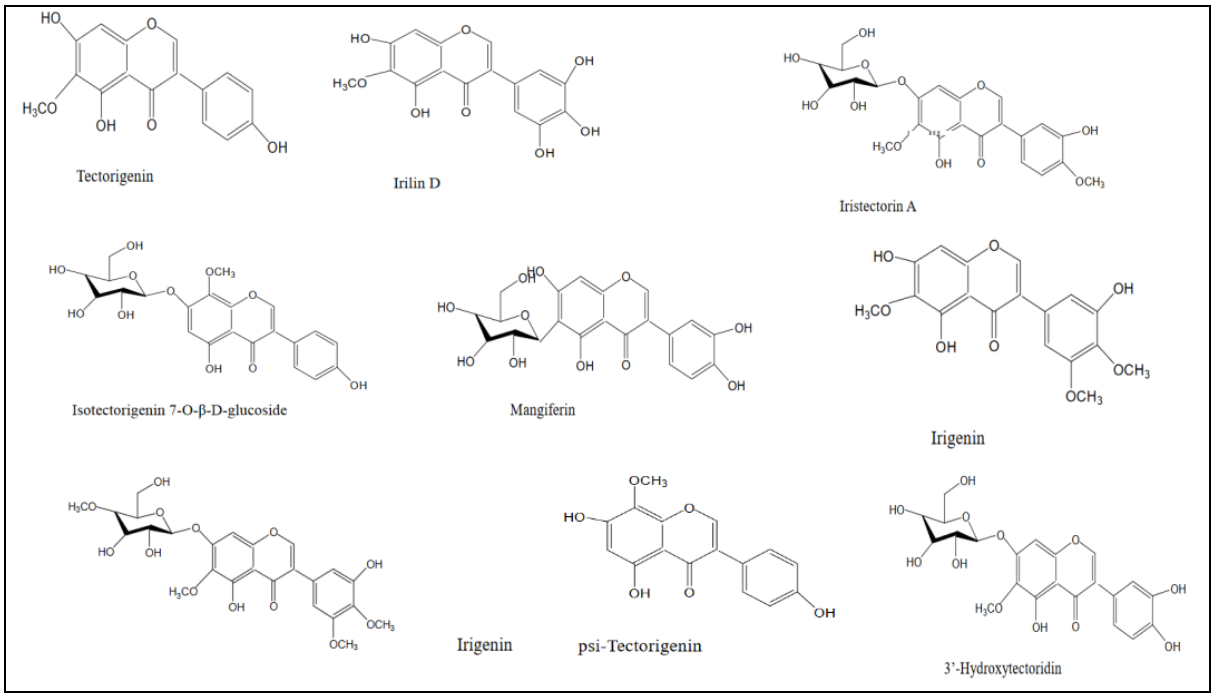

Fig. Structure of Bioactive compound from Belamcanda chinensis.

Antidiabetics Activity

To determine if Belamcanda chinensis is effective in treating diabetes, research was done on its potential as an antidiabetic. The study aimed to assess the effects of the plant's bioactive components on indicators associated to diabetes. The study's findings showed that

Belamcanda chinensis had strong anti-diabetic properties.[25] The plant's extracts showed a significant reduction in blood glucose levels, indicating a possible function in glycemic management. Furthermore, it has been shown that several of the bioactive components in Belamcanda chinensis boost insulin sensitivity, which helps cells better use glucose. Additionally, Belamcanda chinensis was linked to antioxidative capabilities according to the study. The plant's extracts demonstrated the capacity to counteract free radicals, which are involved in oxidative stress, a factor that can lead to issues associated to diabetes. Beta cells in the pancreas, which are essential for the synthesis of insulin, may be protected against or damaged less frequently by Belamcanda chinensis via lowering oxidative stress.[26]

Antitumor Activity

The purpose of the investigation was to determine whether Belamcanda chinensis might effectively suppress the development of tumors. The aim of the study was to evaluate the effects of certain plant-present bioactive chemicals on different aspects of carcinogenesis. The study's conclusions showed that Belamcanda chinensis has strong anticancer properties. Bioactive substances, especially flavonoids like kaempferol that are present in the plant, have been shown to have an inhibitory effect on tumor cell growth. These substances have also been shown to trigger apoptosis, a process of planned cell death that is essential for regulating aberrant cell proliferation.[27,28] Moreover, it was shown that extracts from Belamcanda chinensis have anti-angiogenic qualities. The development of new blood vessels, or angiogenesis, is a crucial step in the growth and spread of tumors. The plant's components shown potential in limiting angiogenesis.[29] The study emphasizes how common prostate cancer is in Western nations and how nutrition may play a role in it. The potential of phytochemicals, especially phytoestrogens, to inhibit the progression of prostate cancer via modifying androgen receptor activation is being investigated. Promising therapeutic targets identified in the study include matrix metalloproteinases, telomerase, IGF-1 receptor, androgen receptor co-activator PDEF, as well as the prostate-specific gene DD3 PCA3.[23] Studies on phytochemicals from Belamcanda chinensis, including tectorigenin, suggest that they can change the expression of certain genes in prostate cancer cells and have encouraging results when it comes to the formation of tumors in animal models. The development of new capillary blood vessels, or angiogenesis, is a strictly controlled process that is essential for physiological processes including the female reproductive system and wound healing. Numerous diseases, including as cancer, diabetic retinopathy, and arthritis, can be brought on by dysregulation. Angiogenesis is aided by prostaglandin E2 (PGE2), which is produced from

arachidonic acid by the enzymes COX-1 or COX-2. Consistent use of NSAIDs, such as aspirin, which block COX, has been associated with a 40–50% lower risk of colon cancer. Because COX-2 is linked to tumor-induced angiogenesis, its anti-angiogenic properties can be addressed. East Asian plant Belamcanda chinensis contains isoflavonoids such tectoridin and tectorigenin, which have been demonstrated to prevent the synthesis of PGE2.[31] The current work investigates the anti-angiogenic characteristics of tectoridin and tectorigenin, indicating a possible role for these compounds in regulating angiogenesis. Natural substances kaempferol and tectorigenin have both been linked to possible anticancer. Preclinical research has indicated that the flavonoid kaempferol, which is present in a variety of fruits and vegetables, has promise anticancer properties. It is thought to work through a variety of pathways, including as anti-inflammatory, antioxidant, and anti-angiogenic qualities. However, more investigation and clinical validation are needed to fully understand the anticancer potential of this substance as well as the pathways implicated.[32] In lab tests, a flavonoid called tectogenin, which was isolated from Belamcanda chinensis's rhizome, showed promise as an anticancer agent. Tectorigenin has been specifically investigated for its capacity to suppress prostaglandin E2 (PGE2) synthesis and its role in regulating angiogenesis. More investigation, including clinical studies, is required to confirm the safety and effectiveness of tectorigenin as an anticancer drug in humans, even if these results point to a potential role in cancer prevention or therapy.[31]

CONCLUSION

Conclusively, this thorough analysis offers a thorough investigation of Belamcandae chinensis (B. chinensis), including its traditional use, phytochemistry, pharmacology, toxicity, and botany. Even while our knowledge of its bioactive components and therapeutic potential has advanced significantly, there are still important knowledge gaps that need to be filled. It is still critical to find more active molecules, comprehend how different compounds work together, and clarify the precise chemical processes that underlie the biological actions of these chemicals.[34] It is important to investigate holistic treatment techniques. Shegan Decoction is a traditional composition that has been utilized in conjunction with other medicinal plants. More thorough investigations are necessary, nonetheless, due to the paucity of data on the pharmacokinetics, clinical research, and target organ toxicity. The review emphasizes how important it is to create effective programs and value evaluations, especially considering how frequently B. chinensis is combined with other herbal constituents. Moreover, future study should prioritize a more thorough examination of B. chinensis's

toxicity, considering its pharmacological effects. In addition to highlighting the possible effects on healthcare and prospects for novel medication development, the report underscores the increased interest in Belamcandae chinensis rhizoma across the world, as demonstrated by its inclusion in the European Pharmacopoeia. Its pharmacological profile is shaped by the complex interactions among its polyphenolic components, which include mangiferin, stilbenes, xanthone glucosides, and highly methoxylated isoflavonoids. Because of its possible increased bioavailability, B. chinensis is positioned as a prospective candidate for alternative medicine due to the prevalence of highly methoxylated forms. The traditional applications and new scientific discoveries highlight the necessity for more thorough physiological and pharmacological investigations to fully realize B. chinensis's medicinal potential. Additionally, to enable its logical implementation in contemporary phytotherapy, study should concentrate on comprehending the intricate relationships that exist between diverse activities and the composition of phytochemicals. In summary, this analysis establishes a framework for future investigations focused on deciphering the complexities of B. chinensis, cultivating a more profound comprehension of its modes of action, and expediting the creation of more efficacious medicinal compounds.[43]

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