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A REVIEW OF TRADITIONAL AND PHARMACOLOGICAL USES OF CROTON BONPLANDIANUM WITH SPECIAL REFERENCE TO THE PHYTOCHEMICAL ASPECT

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ABSTRACT

A plant-based medical practices continue to play a major role in the healthcare system, providing primary healthcare to almost 80% of people globally. Approximately 25% of medications and several synthetic analogs derived from prototype molecules identified from medicinal plants are currently known to exist in the field of medical plant research. Within the Euphorbiaceae family, the genus *Croton* contains about 1,300 species that are widely distributed in tropical regions of both the Old and New Worlds. In Africa, Asia, and South America, the traditional usage of medicinal plants dates back many species. In traditional medicine, *croton bonplandianum* L. (Euphorbiaceae) is used extensively for a variety of conditions, including yellowing of the skin acute diarrhea, intestinal drops, vomiting, cutaneous injuries elevated cholesterol levels, hypertension, and infectious illnesses. The plant's parts are extensively utilized to treat a variety of diseases in traditional medicine, such as internal abscesses, acute constipation, abdominal dropsy, hepatoprotective, body swelling, hypertensive, antioxidant, wound healing, anti-fungal, anti-microbial, anti-diabetic, anti-tumor, and anti-cancer. The plant is in high supply since traditional multiplication occurs at a slow pace. Numerous in vivo and in vitro investigations confirmed its traditional medical applications. For the purpose of this study, we collected comprehensive

information on the taxonomy, publications, transport, shape, Studies on the pharmacological properties, phytochemistry, and traditional uses of the *Crotonbonplandianum* plant.

KEYWORDS: *Croton Bonplandianus*, Phytochemical, bioactive compound, pharmacology, Anti-Oxidant Activity.

INTRODUCTION

The unnatural weed *Croton Bonplandianus* is Monologues. Usually, the plant is 30 to 40 cm Tall. Wharled Ranches grow in height along roadsides and railways; sandy clay soil, rice fields in wide ravines, and abandoned fields of sugarcane. The species is reportedly found only in Bangladesh, India, Pakistan, northern Argentina, southern Bolivia, southwest Brazil, and northern Argentina.It is frequently employed in India, which is in West Bengal's Sub-Himalayan area. This plant is commonly referred to as Ban Tulsi because its leaves and flower cymes resemble those of Tulsi.[1-3] The antioxidant qualities of plants are among their medical advantages that have drawn greater attention because of their role in preventing and controlling a variety of oxidative damages caused by free radicals in the body. Because of their instability, free radicals lead to oxidative stress. In healthy cells, stability is achieved by collaborating electrons with biological macromolecules including proteins, lipids, and DNA. Human cells can damage DNA and proteins as well. The oxidation of liquid. These structural alterations cause several diseases, including cancer, atherosclerosis, cardiovascular issues, aging, and Diseases.[4,6] *Croton bonplandianum Baill* is a locally consumed plant in Pakistan, although its antioxidant properties have not been fully developed. If such information is made accessible, it may not only help to establish plants that are easily available, cost-effective sources of natural antioxidants, but it may also help to support the necessity of continuing domestication efforts on specific species. To assess the antioxidant qualities of *Croton bonplandianum Baill* in a few various in vitro research methods against this framework. Diterpenes, phorbol esters, such as12- orthotrideconeoly-phorbol-13-acetate, and phorbol esters are all present in *Croton bonplandianum* seeds. Phorbol Myristoyl acetate (MPA) is a TPA prostaglandin metabolism-altering carcinogen Fresh plant juice is used to fight against ethnic groupings that are a hassle.[7-8] vegetation's latex has a healing impact on cuts and wounds. In the current study, the research of various phytochemical kinds in terms of quality as well as in quantity, such as tannin, phlorotannin, phenolic, flavonoid, terpenoid, glycoside, steroid, alkaloid, cholesterol, saponin, and anthraquinones precise balance of protein and carbohydrates gaining knowledge of the phytochemical condition of the *C. bonplandianus*

stem, which might be useful to future researchers when analyzing this species' pharmacological properties. Numerous applications exist for croton species. The treatments for cancer, diarrhea, diabetes, dysentery, digestive issues, external wounds, fever, elevated cholesterol, elevated blood pressure, irritation, intestinal worms, malnourishment, pain, inflammation, and weight loss are among the frequently documented uses. In some regions of India, arthritis was treated by placing a heated poultice containing powdered leaves of C. californicus on the joint in question (Wilson et al., 1976). *Croton* nuts, like those from C. megalocarpus, have lately shown to be a more affordable source of ethanol than Kenya's Jatropha. Although the seed plants need up to 20,000 liters of liquid to create one liter of biodiesel, cotyledon trees, which are native to Kenya, yield around 0.35 liters of oil per kilogram of nuts. This study aims to present the conventional value, photochemistry, and toxicology for *C. bonplandianum* to point out research gaps and areas in which more investigations are needed.[9-10] It has also been shown that *C. bonplandianus* has anti-helminthic, hepatoprotective, analgesic, and hypertension effects.[11,13]

Kingdom	Plantae
Subkingdom	Tracheobionata
Super division	Spermatophyte
Division	Magnoliophyte
Class	Dicotyledons
Subclass	Rosidae
Order	Malpighiales
Family	Euphorbiaceae
Subfamily	Crotonoideae
Tribe	Crotoneae
Genus	Croton
Species	*Croton bonplandianus*

Ecological importance- In hot weather conditions, the species *Croton* bonplandianum provides nourishment and nectar. Flowers of *Croton* species are often sat by economically valuable insects such as honey bees, whose pointed inflorescence attracts worker insects.

Fig. 2. Honey bee looming *C.bonplandianum* flowers.

Due to their deep-penetrating roots and woody, scaly stems, and these plants thrive in dry conditions. Even little plants possess lengthy roots that go further down the ground. *C. bonplandianum* flourishing in a desert environment.

Fig. 3: Species of genus *Croton* in hot dry environment.

Appendix A. Common name of *C.bonplandianum*.[14]

S.NO.	REGION/ LANGUAGE	NAME
1.	English	Ban tulsi
2.	Hindi	Kala bhangra
3.	Assamese	Bana tulsi
4.	Bengali	Bon tulsi
5.	kannada	Alpha Bedhi Soppu
6.	Irula	Soraikurvi poo
7.	Tamil	Reilpoondu,Railpindu,Aathuppoondu
8.	Telugu	Bhoothalabhairi,galivanchettu
9.	Bodo	Titabahaphisa
10.	Nepali	Mirchaiya haar
11.	Other	Seemainai Pundu, Ban Tulsi

Traditional uses- It was discovered that South America and Asia were the plant's original home. Because of its antibacterial qualities, C. bonplandianum is utilized to treat respiratory issues, inflammation of the body, and skin illnesses including ringworm infection. Cholagogue and purgative are the chemical compositions of *C. bonplandianum* bark and roots.[15-16] The stems and leaves of *C. bonplandianum* are used to treat diarrhea, stop bleeds

from cuts and lesions on the body, and treat sexual sores. Abdominal dropsy, serious constipation, issues with the liver, and internal abscesses are all treated using this plant's seeds. *C. fresh bonplandianus juice* is used to treat headaches.[17-18] *C.bonplandianum* is widely produced and utilized as a detergent and fuel in the rural parts of Malden. The plant *C. bonplandianum* is widely cultivated and utilized as a detergent and fuel. *C. bonplandianum* stems and branches can be used as fuel. After that, the ash is gathered and stored for five or six days in a containerThe leftover residue dissolves in the warm water and is used as a detergent to clean cotton clothing. The roots and leaves of *C. bonplandianum* are utilized by ethnic groups in rural Indian West Bengal to treat high temperatures and snake venom.[19]

Recent pharmacological studies

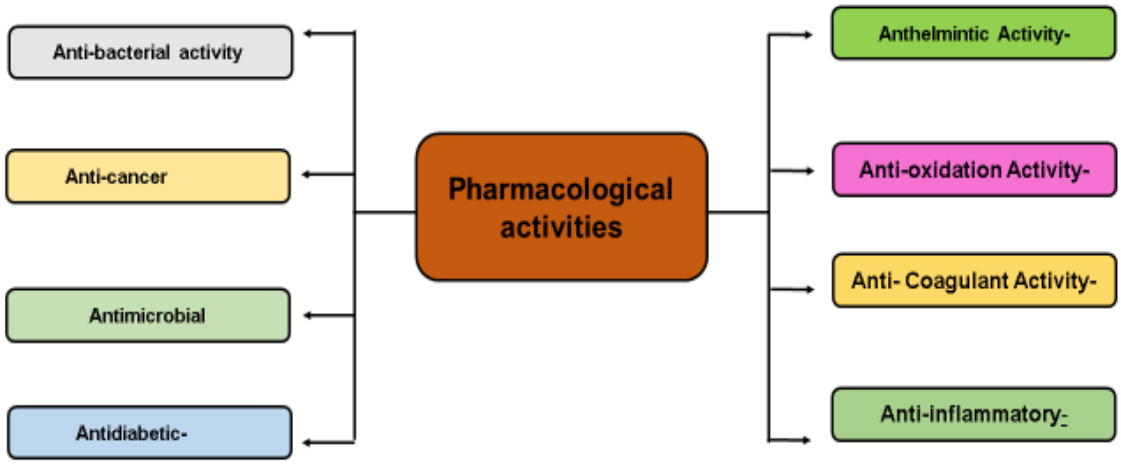

Fig. Role of *Croton bonplandianum* in different activities.

1- **Anti-bacterial activity-** To study the antibacterial activities of *C. bonplandianum* leaves, fruits, latex extracts, and fresh latex, 10% w/v test solutions of the plant's leaves, fruits, and latex were created by combining 500 mg of each extract individually with 5 milliliters of sterile 10% dimethyl sulfoxide (DMSO) Using extracts from the same source, 25, 50, 75, and 100 contained 2.5,7.5, and 10 mg of antibacterial activity, respectively, to evaluate fresh latex. The *C. bonplandianum* whole plant and latex extracts were added into each well of Mueller Hinton Agar (MHA) plates that were already previously infected with the corresponding bacterial cultures at varying doses (2.5, 5, 7.5, and 10 mg), and the plates were then incubated at 37ºC for a whole day. For this study, 10% DMSO was used as the solvent and streptomycin (10 µ g) as the negative and positive control groups, respectively. After incubation, a zone reader was deployed to measure the inhibition zone's diameter (in millimeters) around the well.[20] The highest

results were obtained when 7.5 mg/75 µl of the different solvent extracts of *C. bonplandianum* leaf were used to test the antibacterial activity against bacterial isolates. Comparing the aqueous leaf extract against other bacterial isolates, it demonstrated a minimum zone of inhibition of 10±1 mm against P. aeruginosa and a maximum zone of inhibition of 15±2 mm against S. aureus. When the Ethanolic leaf extract was applied to several bacterial isolates, it was found that E. acrogens and E. coli displayed the largest zone of inhibition, measuring 22±2 mm, while E. faecalis exhibited the lowest zone of inhibition, measuring 16±2 mm. The leaf acetone extract's most significant zone of inhibition against E. acrogens and E. coli was 19±2 mm, while its smallest zone of inhibition was 10±1 mm. While the leaf extract in benzene displayed inhibition of 20±2 mm against S. aureus, the leaf extract in chloroform exhibited inhibition of19±2 mm against Escherichia coli and S. aureus.[21,22]

2- **Anti-cancer-** Originating from Southeast Asia, the green shrub Croton bonplandianum is a member of the Euphorbiaceae family. The primary active component of croton oil, 12-O-tetradecanoylphorbol-13-acetate, Topical administration of 7,12-dimethylbenz(a)anthracene or other aromatic polycyclic substances to mice's skin that had previously been exposed to them has been utilized as a cancer promoter region, resulting in irritation and inflammation (typical dose: 5–16 nmol, twice a week). TPA has been demonstrated in human malignant cells obtained from patients with melanoma, lung, breast, or prostate tumors to restrict growth, cause apoptosis, or promote development. This information is based on a comprehensive tumor analysis. Growth suppression has been found in prostate cancer cells called LNCaP treated with appropriate dosages of TPA (1-1.6 NM). However, apoptosis was evident in the same cells fed TPA at doses that were many times greater.[23]

3- **Antimicrobial-** According to the National Committee for Clinical Laboratory Standards (1997), the agar disc diffusion technique was used to look into the in vitro antibacterial activity of aqueous extracts (say) of *Croton bonplandianus* against three strains of Gram-positive and four strains of Gram-negative bacteria After keeping the temperature at 45–50˚C, the sterile nutrient media was removed and 100 µL of bacterial suspension containing 108 colony-forming units (CFU)/mL was combined with sterile liquid nutritional agar and added to the sterile Petri dishes. The nutritious agar media plates were first individually soaked in varying concentrations of the extract (10, 25, 50, 75, and

100 mg/mL, for example). Before placing filter discs (5 mm in diameter) on top of them, the plates were allowed to firm. For a whole day, the plates were incubated at 37˚C. A 15–20 minute autoclaving process was used to produce the nutritional agar (HI Media Laboratories Limited, Mumbai, India). Using a scale, the zone of inhibition's diameter-which comprises the disc diameter of 5 mm—was determined. To minimize error, each experiment was run three times, and the mean data were reported.[24-25]

4- **Antidiabetic**-Known as the silent killer, diabetes mellitus is the most common endocrine disorder. It is linked to a group of metabolic disorders that are characterized by persistent hyperglycemia and abnormalities in the metabolism of proteins, carbohydrates, lipids, and acids due to deficiencies in either insulin action or secretion. It is a medical disorder where blood sugar, or glucose, rises. Lack of insulin keeps sugar from entering cells where it is needed for energy. The antidiabetic activity was covered by Goldie Uppal et al. in 2012. Animal screening models were used to assess Euphorbiahirta Linn's ethanol extract. For 21 days, alloxan was given to cause hyperglycemia. In rats given alloxan-induced diabetes, the ethanol extract had a hypoglycemic effect—a significant drop in blood glucose levels. Widharna et al. (2010) investigated the antidiabetic effect in vivo and in vitro. In the in vitro experiment, the glucose inhibitory activity was seen in the ethanol extract and tumor Acti chloroform, which is butanol, and water fractions. The outcome of the in vivo test was the same as well. The hirta Euphorbia L. ethanolic and ethyl acetate extracts demonstrated α-glucosidase inhibitory and anti-diabetic effects in both in vitro and in animal tests.[26-27]

5- **Anthelmintic Activity**-The method was used for performing the anthelmintic activity. The adult Indian earthworm Pheretima prothema resembles human intestinal roundworm parasites in both anatomy and physiology.[28] Pheretima prothema was placed in a Petri dish containing three different concentrations of solutions containing Croton bonplandianum (20, 40, and 60 mg/ml) in pet ether, water extract, and ethanol. Each petri dish was supplemented with six worms, and the worms' paralysis or mortality was observed. The amount of time on average that paralysis lasted when there was no noticeable movement was recorded. When it was shown that the caterpillars were not moving in response to shaking or outside stimuli, the length of worm death (minutes) was noted. Albendazole was similarly provided as a reference.[29]

6- **Anti-oxidation Activity-***C. bonplandianum* ethanolic extracts demonstrated DPPH and hydroxyl radical scavenging capabilities. *C. bonplandianum* leaf hydro-ethanolic extract has shown strong free radical scavenging ability.[30] Its *C. bonplandianum* leaf chloroform fraction demonstrated a nitric oxide scavenging assay, reducing power capacity, and free radical scavenging activity.[31] In addition, the n-hexane, and ethyl acetate fraction of *C. bonplandianum* leaves had less antioxidant activity than the chloroform fraction.[32] The ethanolic leaf extract of C. bonplandianum showed excellent free radical scavenging activity (IC50=170.3µg/mL), however, the total antioxidant content was found to be 214 ±0.20 µg/mL.[33] An ethanolic extract of dried C. bonplandianum leaves showed a scavenging effect against free radicals and nitric oxide.[34]

7- **Anti-Coagulant Activity-** A single-use plastic syringe was utilized by Raja K ET al. to extract blood samples from healthy subjects. The cells were subsequently subjected to anticoagulation in a polymer container with 3.8 percent disodium citrate (9 parts solution to 1 part blood). Immediately after, it was centrifuged for fifteen minutes at 4000 × g, separating and pooling the plasma. The freshly generated plasma was kept at 4ºC until it was used. 0.1 ml of diluted test plasma and EDTA was added to a test tube, which was then rapidly shaken to combine the reagent and plasma.The tube was incubated for twenty seconds at 37ºC. After the incubation period, the mixture of plasma and reagent was forcibly combined using 0.1 ml of prewarmed calcium chloride solution.[35] For the negative control, normal saline was substituted for the extracts, and for the positive control, 50 mg/ml of commercial heparin was employed.[36] Impact of entire plant and leaf aqueous and ethanol extracts on Prothrombin time (PT).

8- **Anti-inflammatory-** An evaluation of the C. bonplandianum leaf ethanolic extract was conducted on human blood vessel membranes. An amount of 83.2% was prevented from hypotonicity-induced human blood vessel membrane lysis by ethanolic extract (200 mg/ml).[37] An assessment was conducted on the anti-inflammatory features of C. bonplandianum hydro-alcoholic leaf extract. Rat model of pow edema produced by carrageenan After four hours of treatment, a hydro-alcoholic leaf extract of C. bonplandianum signdefiantly reduced the rat paw edema caused by carrageenan.[38]

An aspect of Croton Bonplandianum's phytochemistry

There are several different kinds of biomolecules in the genus Croton. Diterpenoids are the main components of the genus' secondary metabolites; these might be of the skeletal kinds

are cembranoid, clerodane, neo clerodane, Hali mane, kaurane, secokaurane, labdane, phorbol, and trachylobane. Several *Croton* species have been discovered to have steroidal or pentacyclic terpenoids. Mono- and sesquiterpene-containing volatile oils are common in the species, as are substances generated from shikimate. According to reports, some species are sources of several alkaloids, which significantly increases the genus' significance from a medical standpoint. Phenolic compounds mostly flavonoids, lignoids, and proanthocyanidins have been the subject of several research. In 2007, Salanto et al. Some species of Croton have red sap because they contain alkaloids and/or proanthocyanidins. The latter might be any of several benzyls that are related to quinolones, or it could be Taspine. Particularly prevalent in Croton are diterpenes such as clerodanes, cembranoids, Hari manes, kauranes, laboratory Danes, phorbol esters, trachylobanes, and sarcopetalanes. Some species have volatile oils, which make plants fragrant. Several *Croton* species have produced samples of novel chemical classes, including phenylbutanoids, glutamine alkaloids, and sarcopetalane diterpenes. Although the reality that *Croton* species have been known to include laticifers, no anatomical studies of the secretory structures of volatile oil have been conducted yet. They haven't been much research done with *Croton* species addressing flavonoids. The genus's chemical relations are clear, with species that include trachylobanes, alkaloids, kauranes, and/orlabDanesplacedtogether.Pharmacological tests have regularly confirmed the normal use of *Croton* species. An indanone derivative, two triterpenoids, and three flavonoids are all present in the ethanol extract of *Croton* steenkampianus leaves (Adeboye et al., 2008). Sonderianin, catechin, and gallocatechin have been identified in a methanolic extract of the Croton urucuruna, in addition to an acetyl-aleuritolicacetyl-aleuritolicacetyl-aleuritolicacetyl-aleuritolic acid, stigmasterol, campesterol, sitosterol, sitosterol-O-glucosidesitosterol-O-glucoside (Marize et al., 1997). Phytochemicals According to reports, the plant's primary ingredient is rutin (C18 H36 O19), which works in conjunction with crotsparinine, crotosparine, and its methyl counterparts phorbol to promote wound healing. In addition to flavonoids and alkaloids, the plant also includes two other chemical groups called terpenoids and glycosides. Croton bonplandianum bio-crude extraction produces a wasted residue that is abundant in biopolymers, including lignin, hemicellulose, and cellulose. This may produce oil and ethanol (Sharma et al., 1990). According to a study conducted by Jeeshna et al. (2011), Methanol was much more effective than Acetone, Chloroform, and Petroleum Ether at extracting Croton bonplandianum contains flavonoids, alkaloid glycosides, steroids, tannins, saponins, and resins.. (table 1). However, alkaloids and saponins are absent from the chloroform fraction. 3-hydroxy urs-12, 15-dien of the ursane skeleton, oleanolic acid, ursolic

acid, and sitosterol are a few triterpenoid chemicals discovered in the root of *C. bonplandianum* (Ghoshet al. 2013). Alkaloids, including pro porphine, isoquinoline ionone, sparsiflorine, crotoflorine, crotsparine, and crotosparinine, are found in the plant's leaves. Tetrahydroglazievine, vomifoliol, taraxerol, and sitosterol are abundant in the stem and leaves. Additionally, leaves contain rutin (C18H36O19). The leaf included the following: phthalic acids, bis (7-methyl octyl) ester (1.80%), phytol (1.39%), 2-benzenedicarboxylic acid, dioctyl ester (5.56%), and 16-Hexadecanoyl hydrazide (88.69%). Croton bonplandianum seeds contain these substances as well as phorbol esters including myristoyl phorbol acetate and 12-orthotrideconeoly-phorbol-13-acetat.

Table 1: *Croton* metacarpus leaf extract in ethyl acetate: a phytochemical analysis.

S.no	Phytochemical analysis	Intensity
1.	Alkaloids	+++
2.	Tannins	++
3.	Flavonoids	+
4.	Triterpenes	-
5.	Steroids glycosides	+
6.	saponis	+

+ Weally present , ++stronglypresent , +++verystrongly, -absent

Prospective future

The present review granted the biological significance, phytochemistry, and clinical uses of croton banplandium. Humanity has always been driven by the pursuit of knowledge and invention, which is primarily to blame for the normal lifestyle that before the emergence of humans, plants existed. It is hard to overstate the role that plants play in medical care. Joys now. A nation's natural resources have a crucial role in its development. Therefore, knowledge regarding the evidence base for these Indian herbal remedies would hopefully improve the global knowledge about them. Vegetation. Rich dividends from this will be realized in the upcoming years. Around 1800 species are employed in traditional Indian healthcare systems. The burgeoning business of medicinal herbs has a lot of promise for the Indian region's economic growth. The use of plants for food, medicine, and fragrances is becoming more and more common. Nutraceuticals are dietary supplements that have been scientifically and nutritionally upgraded, and they have recently been demonstrated to have health benefits. The results of the investigation showed that C. bonplandianum, a traditional plant that is frequently utilized as a possible source for medications including Wide-spectrum antibacterial capability was demonstrated against bacterial isolates of gram-positive as well

as gram-negative bacteria by the anti-cancer, anti-microbial, insectifuge, nematicide, anti-coronary, and hepatoprotective actions. Therefore, more investigation is required to separate, recognize, describe, and clarify the nature of these bioactive substances that provide *C. bonplandianum* with its therapeutic properties. Twenty-one main phytocompounds of *C. bonplandianum* were found in various parts of the plant, including the leaf, fruits, and latex, in the current study. In this case, more investigation is needed to eradicate this kind of sickness.

CONCLUSIONS

According to the study's findings, the traditional plant *C. bonplandianum* exhibited broad-spectrum antimicrobial properties against Gram-positive and Gram-negative bacterial isolates. This plant is frequently used as a potential source for medications with anti-inflammatory anticancer, antibacterial, insectifuge, nematicide, anticoronary, and liver-protective properties. Thereby, more investigation is required to distinguish between, describe, and clarify the chemical makeup of these bioactive substances that give *C. bonplandianum* its therapeutic properties. Twenty-one main phytochemicals were found in the current study in *several C. bonplandianum* components, including the fruit itself, the leaf, and latex. In this case, more investigation is needed to eradicate this kind of sickness. Current pharmacological studies have been focused on assessing liver-protective, wound-healing, anti-inflammatory antibacterial, antifungal, anticancer, and antioxidant properties. To conduct this kind of study, institutions must collaborate with scientists and researchers. Finally, but just as importantly, people need to know enough about this sickness and continue to be aware of it. *C. bonplandianum* to spearhead their clinical applications and create effective medications.

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