



A Brief Review On Salubrious Properties Of Caesalpinia Bonducella

Shinde Anjali Raghuvir ¹, Dhanashri Pramod Puri ², Swarada vivek Shevatekar ³,

Shruti Satish Garad ⁴, Ashwini Vasantrao Patil ⁵

Lokmangal college of pharmacy wadala, Solapur.

Lokmangal college of pharmacy wadala, Solapur.

Amepurva Forum's Nirant Institute of Pharmacy, Boramani , Solapur.

Dattakala college of pharmacy, Bhigwan tal. daund dist. Pune.

Abstract: - *Caesalpinia bonducella* L. also known as “fever nut” Bonduc nut and Nicker nut belongs to the family of Caesalpinaceae and has been reported in Folklore medicine and ancient Ayurveda scriptures. *Caesalpinia bonducella* has been shown to provide significant benefits for human health. It effectively treats PCOS and has antiseptic, antibacterial, anti-inflammatory, antidiuretic, anthelmintic, antipyretic, anticonvulsant, antidiarrheal, antiviral, antiasthmatic, anti-anaphylactic, antiamebic, and antiestrogenic properties. It can treat a wide range of diseases. The study examined Pharmacognostic, phytochemical, and quality parameters, including microscopic and macroscopic studies. The ethanolic extract contained flavonoids, saponins, alkaloids, steroids, and resins. Research is needed to produce effective formulations without the negative effects associated with continuous therapy for illnesses such as PCOS, which often require long-term pharmaceutical use.

Key Words: - fever nut, Aldose reductase inhibitory activity, Anticancer, Antibacterial

Introduction: - *Guilandina bonduc*, commonly known as grey nicker, nicker bean, (1) fever nut (2) or knicker nut, is a species of flowering plant in the senna tribe, Caesalpinieae,(3) that has a pantropical distribution.(4) It is a liana that reaches a length of 6 m (20 ft) or more and scrambles over other vegetation. The stems are covered in curved spines. (5) Its 2 cm (0.8 in) grey seeds, (6) known as nickernuts, (7) are buoyant and durable enough to be dispersed by ocean currents. (8) It belonging to the family -Caesalpinaceae which is most commonly found in tropical regions of India, Sri Lanka and Andaman and Nicobar Islands thus widely distributed all over the world

(9). The term *Bonducella* which is the name of dominant species is derived from an Arabic word *Bonduce* a signifies it as a little ball which denotes the globular shape of the seed (10). *Caesalpinia bonducella* (Karanjwa) is extensively used for its medicinal properties (11-13). It is an irregular thorny shrub consisting of large bipinnate leaves and yellowish flowers. Fruits are termed as inflated pods bearing 1– 2 seeds (14). Its leaves are conventionally being used in the treatment of topical inflammation and are found to possess antidiuretic, anthelmintic, antipyretic, antibacterial, anticonvulsant, antidiarrhoeal, antiviral, antiasthmatic, anti-anaphylactic, antiamoebic and antiestrogenic (15). The plant is rich in many therapeutically active constituents like flavonoids, carotenoids, glycosides, steroids and phenols (16).

For thousands of years, the *Caesalpinia species* has played a very major role in maintaining human health and improving the quality of human life by serving as useful components of medicine, seasonings, beverages, cosmetics, and dyes. *Caesalpinia species* have long been used in various traditional medicines of India as well as the rest of the world in managing varied symptoms and ailments. All part of this species (root, seed, bark, leaves, and flowers) has been utilised for various medicinal purposes, and the root, stem, leaves, bark, seeds, and nuts have all been used in some way.

Moreover, these species are reported for several interesting biologically and pharmacologically important bioactive secondary metabolites that possess a novel structure with a diverse mechanism of action, attracting the pharmaceutical industries to develop novel drug formulation based on the herbal route.

Pharmacognostic Properties: -

The physical qualities of plant material were evaluated organoleptically, as shown below:

Characteristics of seed:

Colour: grayish green

Odour: characteristic

Shape: ovoid

Taste: rancorous

Size: 1.3 cm



Characteristics of leaf:

Colour: green

Taste: rancorous

Texture: burnished

Size: 5 -7cms

Type: bipinnately Compound



Leaf

Characteristics of stem:

Colour: brown

Size: 1.8 – 2.0 cm

Type: Hardy and woody



Stem

characteristics of root:

Colour: brown

Type: deep and tap roots

Microscopy of leaf:

Transverse section of leaf shows single layered epidermis which is covered with cuticle. It contains 1-3 celled trichomes, thin-walled parenchymatous cells. Presence of vacscular bundles shows secretory cavities in phloem .

Synonyms:- (17-22)

- Bonduc minus Medik.
- Caesalpinia bonducella (L.)Fleming
- Caesalpinia crista L., p.p.A
- Caesalpinia cristata Prowazek
- Caesalpinia grisebachiana Kuntze
- Caesalpinia sepiaria Auct. non Roxb.
- Caesalpinia sogerensis Baker f.
- Guilandina bonduc Griseb.
- Guilandina bonducella L.



- Guilandina crista (L.)Small
- Guilandina gemina Lour
- Guilandina bonduc L.
- Guilandina bonducella (L.)Fleming

Common Names :- (17-22)

Sr.No.	Various Language	Names
1	Marathi	कटुकरंज Katukaranja सागरगोटी Sagargoti
2	Assamese	Letaguti-goch Letai-goch লেটাগুটি Letaguti
3	Bengali	নাটাকরঞ্জ Natakaranja
4	English	Bonduc nut Fever Nut Fever-Nut Physic nut Physic-Nut
5	Hindi	Kat Karanj कटकरंज Kat-karanj कटकलेजी Kat-kaleji गजगा Gajga पट्टिल Pattil पांशुल Panshul पूतिक Putik पूतिकरंज Putikaranj
6	Kannada	ಗೆಜ್ಜುಗೆ Gejjuga
7	Konkani	गझगो Gazgo
8	Oriya	Gila

Chemical Properties: -

- Seeds yield a bitter, resinous principle, named bonducin.
- Fatty oil yields glycerides of palmitic, stearic, lignoceric, oleic, and linoleic acids, two phytosterols and a hydrocarbon similar to heptacosane.
- Study isolated four known cassane-type diterpenes and three new norcassane-type diterpenes.
- Phytochemical studies of seeds have revealed alkaloids, flavonoids, glycosides, saponins, tannins and triterpenoids.
- Study yielded ten new furanocassane-type diterpenes, caesalpinins H-P (1-9) and norcaesalpinin F (10) from seed kernels, together with 13 known diterpenes. (23)
- Petroleum ether extract of seeds yielded saponins, glycoside, starch, sucrose, proteins, sterols, and reported constituents like homoisoflavone (bonducillin) and a non alkaloid bitter principle (natin). (24)
- Various seed extracts yielded bioactive molecules including oils, sterols, saponins, alkaloids, glycosides, phenols, tannins, flavonoids, and resins. (see study below) (25)
- Physiochemical screening of seeds yielded foreign matter 0.97%, loss on drying 8.83%, total ash 3.37%, solubility in water 28.8%, and extractive value in water 6.7%. Phytochemical study yielded alkaloid 0.12 mg/g-1, phenol 0.60 mg g, flavonoid 0.33 mg g, tannins 4.90 mg g, and lignin 74.7 mg g. Nutrient analysis yielded carbohydrate 18.4 mg/g-1, proteins 17.6 mg, fat 3.6 mg, fiber 3.3 mg, and energy value 73.6 kcal. (26)
- Bioassay guided fractionation isolated seven flavonoids viz., 7-hydroxy-4'-methoxy-3,11- dehydro-homoisoflavanone , 4,4'-dihydroxy-2'-methoxy-chalcone , 7,3'-dihydroxy-3,11- dehydrohomoisoflavanone , Luteolin , quercetin-3-methyl ether, Kaempferol-3-O- β -D-xylopyranoside and Kaempferol-3-O- α -L-rhamnopyranosyl-(1 \rightarrow 2)-B-D-xylopyranoside .
- Study of aerial parts yielded a new compound, caesanol 1, and a known diterpene 6 β , 7 β -dibenzoyloxyvoiacapen-5- α -ol.
- Study of roots isolated four cassane furanoditerpenes: bonducellpins A, B, C, and D. (27)
- Phytochemical analysis of leaves powder of *C. bonducella* yielded terpenoids and phenolics (4.490%), alkaloids (0.085%), alkaloids and N-oxides (25.745%), fats and waxes (8.850%) and fibers (60.050%).
- Phytochemical screening of roots powder yielded tannins, flavonoids, anthocyanins, leucoanthocyanins, mucilage, saponosides, anthracemic, heterosids, alkaloids, and quinons.
- Phytochemical screening of seeds yielded steroids and terpenes in the petroleum ether extract, flavonoids, alkaloids, glycosides and tannins in the ethanol extract. GC-MS analysis of saponified matter of PE extract yielded fatty acid viz. hexadecanoic acid and 9-methyyl-8-tridecen-2-ol acetate. (28)
- A new rearranged furanoditerpene, caesalpinin B, was isolated from the roots of *C. bonduc.* (29)

Pharmacological Uses:-**Antimalarial:**

The study identified 44 cassane- and norcassane-type diterpenes. The majority of the diterpenes tested had antimalarial action, with norcaesalpinin E outperforming the medication chloroquine. (30) In a study of six plants used in traditional medicine for malaria, *C. bonducella* and *Cassia abbreviata* leaf ethanol extracts showed the highest promise for future research. (31)

Aldose reductase inhibitory activity / anti-cataract / antioxidant:

Water, ethanol, and chloroform extracts of *Adhatoda vasica*, *Caesalpinia bonduc*, *Cassia fistula*, and *Biophytum sensitivum* were tested for rat lens aldose reductase inhibitory potential (RLAR), anti-cataract, and antioxidant properties. All the extracts significantly inhibited aldose reductase and showed anticataract action. The extracts also shown considerable free radical scavenging action and decreased the activity of enzyme PPO, a model oxidizing enzyme. The plant samples contained high levels of vitamin C, total polyphenols, and flavonoids. (32)

Effect on Contractile Activity of Uterine Smooth Muscle/Leaves:

A study looked at the calcium dependency and cholinergic effects of a *C. bonduc* leaf extract in isolated pregnant rat myometrium preparations. The extract boosted contractile force in isolated strips in a concentration-dependent manner. The effects were comparable to acetylcholine. The results indicate the presence of cholinergic receptors sensitive to the extract, which could influence calcium influx (phasic contraction) and calcium mobilization from cellular stores (tonic contraction), both of which are responsible for increased contractile activity and uterine smooth muscle contracture. (33)

Antibacterial / Antifungal / Antispasmodic / Ca⁺⁺ Antagonistic Effects:

Study evaluated crude extract of *C. bonducella* and its fractions for antibacterial, antifungal, antispasmodic, and CA⁺⁺ antagonistic properties. Strongest antibacterial effect was shown by the n-butanol (72%) and ethyl acetate (80%) fractions. followed by crude extract (46 and 42%) against *E. coli* and *B. subtilis*, respectively. There was maximum antifungal activity against *Candida glabrata* and *Aspergillus flavus*, 80 and 70% respectively. The extract caused concentration-dependent inhibition of spontaneous and high K⁺ induced contraction of isolated rabbit jejunum. (34)

Anticancer Flavonoids / Twigs and Leaves:

Tyrosine kinase (TK), vascular endothelial factor (VEGF), and matrix metalloproteinases (MMP) are important cancer therapeutic target proteins. Study isolated phytochemicals from young twigs and leaves of *C. bonduc*. Seven phytochemicals were isolated viz., 7-hydroxy-4'-methoxy-3,11-dehydrohomoisoflavonone , 4,4'-dihydroxy-2'-methoxy-xhalcone , 7,4'-dihydroxy-3,11-dehydrohomoisoflavonone , luteolin , quercetin-3-methyl , kaempferol-3-O-β-D-xylopyranoside , and kaempferol-3-O-α-L-rhamnopyranosyl-(1→2)-β-D-xylopyranoside . Molecular docking analysis showed strong interactions with the proteins compared with their respective drug

inhibitors. Results suggest promising pharmacokinetic and pharmacodynamic properties with potential as lead compounds for development of new anti-cancer drugs. (35)

Enhancement of Male Sexual Activity / Aphrodisiac Potential / Roots:

This study looked at the potential influence of root extracts on the sexual behavior of male Wistar rats. Sexual behavior was improved in rats treated with ethanolic extract, with a significant increase in mount frequency and intromission, as well as a reduction in mount and intromission latency. There was also an improvement in testosterone levels, relative testicular weight, and histological architecture. The findings show that *C. bonduc* roots have aphrodisiac properties and corroborate their traditional use as such. (36)

Hepatoprotective / Nephroprotective / Gentamicin Induced Toxicity:

This study examined the protective effect of a methanolic extract of leaves on gentamicin-induced hepatotoxicity and nephrotoxicity in rats. The results demonstrated that pretreatment greatly reduced the physiological and histological changes generated by gentamicin. (37)

Female Reproductive System Effects / Antifertility Efficacy:

A study looked at how an ethanolic seed extract affected the reproductive system in Wistar female albino rats. The major hormones, LH, FSH, estradiol, and progesterone, showed a considerable dose-dependent decline. The findings indicated that estrogen antagonistic effects were mediated by a direct influence on reproductive organs, presumably by suppressing follicular growth in the ovary and/or disrupting hormonal balance in the hypothalamo-hypophysial ovarian and uterine axis.

Antidiabetic / Hypoglycemic:

A study found that the seed kernel of *Caesalpinia bonducella* had substantial antidiabetic and hypoglycemic properties. Activity may be attributed to a beneficial effect on glycogen synthesis in the liver, skeletal muscle, and cardiac muscle caused by insulin-like action of its ingredients, as well as a stimulatory effect on insulin release.

Antifilarial / Seed Kernel:

A study found that *C. bonducella* seed kernel extract and fractions had microfilaricidal, macrofilaricidal, and female-sterilizing efficacy against *L. sigmodontin*, as well as microfilaricidal and female-sterilizing efficacy against *B. malayi* in animal models.

Anxiolytic effect:

A study of the seed extract of *C. bonducella* revealed strong and dose-dependent anxiolytic effect.

Adaptogenic activity

Adaptogens, or adaptogenic compounds, are used in [herbal medicine](#) to stabilise physiological processes and promote [homeostasis](#) in the body supposedly. In one study, *C. bonduc* seed extracts were screened for adaptogenic activity using cold stress model and swim endurance model. When the seed coat and kernel extracts were given orally at 300 mg/kg, they recorded strong antistress properties. The extracts also significantly increased the swim endurance time. The stress-induced rats in this [investigation](#) recorded considerable hypoglycemia, as well as a decrease in blood cortisol levels and an increase in total leukocyte count. The seed extracts were found to be effective in resolving these imbalances. Extracts were also found to have a substantial capability for regulating hyperlipidemia caused by the production of stress

Anticataract activity

The ethanolic extract of *C. bonduc* seed kernels. (L) Fleming contains anticataract and antioxidant properties that may be effective in preventing or delaying cataract progression. The extract decreased opacity and tissue Malondehyde (MDA) levels while increasing the activities of catalase and superoxide dismutase (SOD). Water soluble protein levels and total protein levels both increased (38).

Antiulcer activity

The aqueous extract of *C. bonduc* was effective in treating ulcers and having antisecretory properties. Therefore, this plant has the potential to be used to treat stomach issues. In addition, the extract reduced stomach volume, total and free acidity, and elevated the pH of the gastric fluid. The aqueous extract of *C. bonduc* contained saponins, alkaloids, triterpenes, flavonoids, steroids, and tannins, and [flavonoids](#) were found to have antiulcer activity. The methanolic extract of *C. bonduc* leaves has considerable antiulcer activity .

Larvicidal activity

Saravanan et al. has reported the mosquito larvicidal properties of various leaf extracts as well as fixed oil from the seeds of *C. bonduc*. By adapting the WHO guidelines, this group conducted a preliminary laboratory experiment to determine the efficacy of petroleum ether, ethanolic, aqueous extracts of dried leaves, and fixed oil from the seeds of *C. bonduc* at various concentrations against the fourth instar larvae of *Culex quinquefasciatus*. In this experiment, 100% mortality was observed in 1% concentrations of petroleum ether and ethanolic extract of leaf, but 55% mortality was observed in 2.5% concentrations of aqueous extract and 92.6% mortality was observed in 2.5% concentrations of fixed oil. This group concluded that the active ingredient responsible for mortality should be separated. This may become a viable larvicidal agent in the near future that is cost-effective, non-polluting, and environmentally benign [39].

Wound healing

Chandra et al. conducted a study in 2017 to confirm the efficacy of *C. bonduc* and *Cyclea peltata* extracts on diabetic rats' experimentally generated excision wounds. For a period of 15 days, a methanolic and ethyl acetate extract of the test sample was administered in a PEG base and the [wound healing](#) effect was observed. Their findings revealed statistically significant wound contraction in the treated sample of up to 98%, compared to 90% in the diabetic control group. Their findings were connected to fasting blood glucose levels, demonstrating that [hyperglycemia](#) negatively affected wound healing. In animals treated with a high dose (100 mg/kg b.w) of methanolic extract of the aerial part of *Cyclea peltata* and the root of *C. bonduc*, histopathological investigations revealed mild granulation with significant epithelial enclosing and moderate hyperplasia. According to their findings, tested plant extracts enhance [wound healing](#) in diabetic mice, paving the path for further extensive [investigation](#) on the phytochemical ingredient for future medicinal uses. This [investigation](#) adds to the body of knowledge in the field of therapeutic medicine and may even serve as the foundation for the development of herbal-based gel formulations or ointments for treating diabetic wounds, avoiding the need for synthetic medications and their accompanying adverse effects .

Nootropic activity

This research group determined the effectiveness of dried seed kernels of *C. bonduc* extract as a [learning and memory](#) enhancer. The amnesic effect of scopolamine was reduced in mice using an aqueous extract of dried *C. bonduc* seed kernels. The aqueous extract of dried seed kernels of *C. bonduc* was compared to the standard drug piracetam in scopolamine-induced amnesia in mice using the radial arm maze and Morris water maze as exteroceptive behavioural paradigms. Finally, the [statistical analysis](#) was used to test the Morris water maze model for learning and memory and the radial arm maze model for [learning and memory](#) retention .

Cardioprotective property

Kumar et al. investigated the alcohol and aqueous seed extracts of *C. bonduc* in albino rats for their preventive properties against isoproterenol-induced myocardial infarction in 2013. The induced heart injury resulted in higher enzyme levels in the serum and increased lipid peroxide and lower glutathione levels in the heart homogenate. The increased enzyme levels in the serum and heart homogenate were dramatically reduced after pre-treatment with the extracts at a dose of 400 mg/kg orally for 30 days. Histopathological analysis revealed that the extract provided significant protection against cardiac necrosis (40).

Conclusion :-

Caesalpinia bonduc (L.) Roxb. has been used traditionally owing to its multiple pharmacological properties. Its current use in PCOS treatment is gaining popularity among Indians due to its ability to reverse irregularities in

menstrual cycle and lower testosterone levels. Although pre-clinical studies are being conducted on the efficacy of *C. bonducella* to treat several ailments like diabetes, hyperlipidemia, hyperandrogenism, cancer, inflammation, etc., Many herbal remedies have been employed in various medical systems for the treatment and management of different diseases. The plant *Caesalpinia bonducella* (syn: *Caesalpinia crista* Linn.) has been used in different system of traditional medication for the treatment of diseases and ailments of human beings.²⁶ Phytochemicals are a class of molecules found predominantly in tea, grapes, berries, cocoa and other plants. These are known to have diverse pharmacological properties.²⁷ Though they do not have any nutritive value the protective and disease preventing properties have been well explored. It is in this context that the study of the pharmacological properties of *Caesalpinia bonducella* was studied.

Reference: -

- 1) *Caesalpinia bonduc* PlantNet: Royal Botanic Garden, Sydney. Accessed 15 March 2018.
- 2) "Fever nut". Flowers of India. Retrieved 12 September 2020.
- 3) *Caesalpinia bonduc*". *Germplasm Resources Information Network*. Agricultural Research Service, United States Department of Agriculture. Retrieved 2010-12-06.
- 4) Cody, Martin L. (2006). *Plants on Islands: Diversity and Dynamics on a Continental Archipelago*. University of California Press. p. 161. ISBN 978-0-520-24729-1.
- 5) Oudhia, P., 2007. *Caesalpinia bonduc* (L.) Roxb. [Internet] Record from PROTA4U. Schmelzer, G.H. & Gurib-Fakim, A. (Editors). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands.
- 6) Nelson, Gil (1996). *The Shrubs and Woody Vines of Florida: a Reference and Field Guide*. Pineapple Press Inc. pp. 177–178. ISBN 978-1-56164-110-9.
- 7) *Gray Nickarbean or Sea Pearl Caesalpinia bonduc*". *A Seabean Guide*. seabean.com. Retrieved 2010-12-07.
- 8) Cody, Martin L. (2006). *Plants on Islands: Diversity and Dynamics on a Continental Archipelago*. University of California Press. p. 161. ISBN 978-0-520-24729-1.
- 9) Asolkar LV, Kakkar KK, and Chakre OJ. Second Suppl. To Glossary of Indian Medicinal Plants with Active Principles, PID-CSIR, New Delhi, 1992: Part 1,150.
- 10) Handa SS. and Kaul MK., Supplement to Cultivation and Utilization of Medicinal Plants, RRL, Jammu-Tawi, 1996: 727-37.

- 11) Anonymous. Wealth of India Delhi: CSIR Publications. 1956, pp6–8.
- 12) Gamble JS. Flora of presidency of Madras Calcutta: Botanical Survey of India. 1967, pp. 278–279.
- 13) Kapoor LD. Handbook of ayurvedic medicinal plants. Boca Raton: CRC Press LLC. First Indian Reprint, Herbal Reference Library, Replika Press Pvt. Ltd., India. 2008, pp88.
- 14) Prajapati ND, Purohit SS, Sharma AK, Kumar T. A handbook of medicinal plants a complete source book, reprint. Agrobios, Jodhpur, India: Hindustan Printing Press. 2006, p. 100.
- 15) Wadkar GH, Kane SR, Matapati SS, Hogade MG. In-vitro anthelmintic activity of *Caesalpinia bonducella* (Linn). *Flem. leaves. Journal of Pharmacy Research* 2010, 3(5), 926-927.
- 16) Guno SC, Rohan SB and Chaitanya RP (2009) Analgesic activity of chloroform extract of *Caesalpinia pulcherrima*. *J. Pharm. Res.* 2(7), 1199-1200.
- 17) D K Ved, Suma Tagadur Sureshchandra, Vijay Barve, Vijay Srinivas, Sathya Sangeetha, K. Ravikumar, Kartikeyan R., Vaibhav Kulkarni, Ajith S. Kumar, S.N. Venugopal, B. S. Somashekhar, M.V. Sumanth, Noorunissa Begum, Sugandhi Rani, Surekha K.V., and Nikhil Desale. 2016. ([envis.frlht.org / frlhtenvis.nic.in](http://envis.frlht.org/)). FRLHT's ENVIS Centre on Medicinal Plants, Bengaluru. http://envis.frlht.org/plant_details.php?disp_id=384
- 18) Flora of Tamil Nadu, VOL. I, 1983, Flora of Kolhapur District, Yadav S. R & Sardesai M. M, 2002, Biodiversity Documentation for Kerala Part 6: Flowering Plants, N. Sasidharan, 2004, Flora of Karnataka, Sharma B.D, 1984
- 19) *Caesalpinia bonducella* (L.) *Flem.*, *Asiat. Res.* 11: 159. 1810; *Hook. f.*, *Fl. Brit. India* 2: 254. 1878.
- 20) *Caesalpinia bonduc* (L.) *Roxb.*, *Fl. Ind.* 2: 362. 1832; Sanjappa, *Legumes Ind.* 9. 1992; Sasidh. & Sivar., *Fl. Pl. Thrissur For.* 161. 1996; Sivar. & Mathew, *Fl. Nilambur* 229. 1997; Sasidh., *Fl. Periyar Tiger Reserve* 120. 1998; Sasidh., *Fl. Chinnar WLS* 110. 1999; Sasidh., *Fl. Parambikulam WLS* 106. 2002; Sunil & Sivadasan, *Fl. Alappuzha Dist.* 250. 2009; Ratheesh Narayanan, *Fl. Stud. Wayanad Dist.* 320. 2009.
- 21) *Caesalpinia crista* sensu Gamble, *Fl. Pres. Madras* 393(278). 1919, non L. 1753.
- 22) *Guilandina bonduc* L., *Sp. Pl.* 381. 1753.
- 23) [Constituents of *Caesalpinia crista* from Indonesia.](#) / Awale S, Linn TZ, Tezuka Y, Kalauni SK, Banskota AH, Attamimi F, Ueda JY, Kadota S./ *Chem Pharm Bull (Tokyo)*. 2006 Feb;54(2):213-8.

- 24) [Anticonvulsive Effect of Seed Extract of *Caesalpinia bonducella* \(Roxb.\)](#) // A. ALI, N. VENKAT RAO, MD. SHALAM, T. SHIVARAJ GOUDA and S. M. SHANTAKUMAR / IRANIAN JOURNAL OF PHARMACOLOGY & THERAPEUTICS / IJPT, July 2009, Vol 8, No 2: pp 51-55.
- 25) [Preliminary phytochemical and antifungal screening of various organic extracts of *Caesalpinia bonducella* seeds](#) / SHRUTI SHUKLA, PRADEEP MEHTA, ARCHANA MEHTA, SURESH PRASAD VYAS, VIVEK K. BAJPAI* / Romanian Biotechnological Letters Vol. 16, No. 4, 2011
- 26) [Studies on Nutraceutical Properties of *Caesalpinia bonducella* L.: An Indian Traditional Medicinal Plant](#) /S. Manikandaselvi, V. Vadivel and P. Brindha / Research Journal of Medicinal Plants, 2016, Volume: 10, Issue 2, Pp 127-139 / DOI: 10.3923/rjmp.2016.127.139.
- 27) [Bonducellpins A–D, New Cassane Furanoditerpenes of *Caesalpinia bonduc*](#) / Sonia R Peter, Winston F Tinto, Steward McLean, William F Reynolds and Margaret Yu / J. Nat. Prod., 1997, 60 (12): pp 1219–1221 / DOI: 10.1021/np970308c.
- 28) [Evaluation Isolation and Characterization of Chemical constituents from *C. bonducella* L. seed](#) / Sunayana Vikhe, Sunil Nirmal / Pravara Journal of Science of Technology 2017; 1(1)
- 29) [Caesalpinin B, a rearranged cassane furanoditerpene of *Caesalpinia bonduc*](#) / Deon Lyder, Winston Tinto, Suzanne Bissada, Stewart McLean, William Reynolds / Heterocycles, 1998; 48(7): pp 1465-1469.
- 30) [Antimalarial Activity of Cassane- and Norcassane-Type Diterpenes from *Caesalpinia crista* and Their Structure–Activity Relationship](#) / Surya Kant Kalauni et al / Biological & Pharmaceutical Bulletin Vol. 29 (2006) , No. 5 1050
- 31) [Screening of Traditionally Used Plants for In Vivo Antimalarial Activity in Mice](#) / Esther Innocent et al / Afr J Tradit Complement Altern Med. 2009; 6(2): 163–167.
- 32) [Aldose reductase inhibitory, anti-cataract and antioxidant potential of selected medicinal plants from the Marathwada region, India](#) / R N Gacche, N A Dhole / Natural Products Research, 2011; 25(7) / DOI: <https://doi.org/10.1080/14786419.2010.536951>
- 33) [Effects of leaf extract of *Caesalpinia bonduc* \(Caesalpinaceae\) on the contractile activity of uterine smooth muscle of pregnant rats](#) / J Y Datté, A Traorém A M Offoumou, A Ziegler / Journal of Ethnopharmacology, March 1998; 60(2): pp 149-155 / DOI: [https://doi.org/10.1016/50378-8741\(97\)00144-X](https://doi.org/10.1016/50378-8741(97)00144-X).

- 34) [Antibacterial, antifungal, antispasmodic and Ca⁺⁺ antagonistic effects of *Caesalpinia bonducella*](#) / Hidayat Ullah Khan, Irshad Ali, Arif-Ullah Khan, Rubina Naz, and Anwarul Hassan Gilani / Natural Products Research, 2011; 25(4) / DOI: <https://doi.org/10.1080/14786419.2010.529445>.
- 35) [Potential Anti-Cancer Flavonoids Isolated from *Caesalpinia bonduc* Young Twigs and Leaves: Molecular Docking and In Silico Studies](#) / Franklyn Nonso Iheagwam, Olubanke Olujoke Ogunlana, Oluseyi Ebenezer Ogunlana et al / Bioinformatics and Biology Insights, 2019 / DOI: <https://doi.org/10.1177/1177932217721371>.
- 36) [A comparative study of *Caesalpinia bonduc* \(L.\) Roxb. root extracts on sexual behavior in male Wistar rats](#) / Mariette Sindete et al / Andrologia, e14072 / DOI: <https://doi.org/10.1111/and.14072>
- 37) [Protective Effect of Methanolic Leaf Extract of *Caesalpinia Bonduc* \(L.\) on Gentamicin-Induced Hepatotoxicity and Nephrotoxicity in Rats](#) / A. ALI NOORANI, K. GUPTA, K. BHADADA and M. K. KALE / IJPT 10: 21-25, 2011.
- 38) Pudhom K, Sommit D, Suwankitti N, Petsom A. Cassane Furanoditerpenoids from The Seed Kernels of *Caesalpinia bonduc* from Thailand. J Nat Prod. 2007; 70: 1542-1544.
- 39) Parameshwar S, Srinivasan KK, Rao CM. Oral Antidiabetic Activities of Different Extracts of *Caesalpinia bonducella* Seed Kernels. J Pharmaceut Biol. 2002; 40: 590-595.
- 40) Yapo PA, Kouamãf Â© KGG, Kati CS, Amoikon KE, Offfoumou AM. Leaf extract of *Caesalpinia bonduc* Roxb. (Caesalpinaceae) induces an increase of contractile force in rat skeletal muscle in situ. Phytomedicine. 2004; 11: 235-241.