



## Review on *Caesalpinia bonducella*

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### ABSTRACT

*Caesalpinia bonducella* L. is a medicinal plant belonging to the family caesalpinaceae. It is a prickly shrub widely distributed all over the world especially in Indian tropical regions such as Kerala, Andaman and Nicobar Islands and Sri Lanka. Plants are the mother of all medicines. Nature has bestowed upon us an in exhaustible treasure of miracles that can heal and restore the balance caused by various anomalies that assault the human body. Man has learned from nature and tried to mimic its elements to re-establish the harmony in the ailing body. The practice of use of plants to alleviate pain and suffering incurred by various disorders and to accentuate health can be evidenced from various manuscripts through ages since the dawn of civilization and even beyond the time of inception of hieroglyphics. The plant *C. bonducella* grows avidly in a warm tropical climate and is found with high propensity throughout India. It is an evergreen plant with deep roots, woody-hard stem, oval-shaped, compound elliptical glossy leaves arranged alternately on either side of the branch. The plant bears dicotyledonous seeds with a characteristic odor. Various parts of the plant are loaded with various phytochemicals that have the potential to defeat a more than enough of anomalies like hyperlipidemia, spasms, immunomodulation, etc. to name a few. But this natural wonder drug is slowly slipping into the darkness of extinction due to a decline in its population. The decreasing demography of the plant is due to the protracted period of dormancy of its seed coupled with overutilization of the plant parts for medicinal purposes and destruction of its habitat.

**Keywords:** *Caesalpinia bonducella*, physicochemical properties, chemical constituent, pharmacological studies, seeds.

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### INTRODUCTION

*Caesalpinia bonducella* L. plant (fig.1) is also known as "fever nut", belongs to family caesalpinaceae.<sup>1-3</sup> *C. bonducella* is a huge thorny shrub known to be a local of South India, Burma and Ceylon, especially along the ocean drift and up to 2500 ft. in hilly regions.<sup>4</sup> *C. bonducella* used as a herbal medicine derived from Kingdom: Plantae, Order: Febales, Family: Caesalpinaceae, Genus: *Caesalpinia*, Species: *C. bonducella*; Part used: Seeds (Fig.2) of *C. bonducella* commonly known as Kakachika, Karanja. It is accounted in this literature that most parts of the plant has therapeutic properties, however, much has been studied with the seed and shell. The alkaloids in *C. bonducella* are known to be found in shell, seed and twigs. The active molecule bonducin is present in the seed as an incredible glycoside also saponins and terpenoids are additionally known to be found in seed.<sup>5</sup>

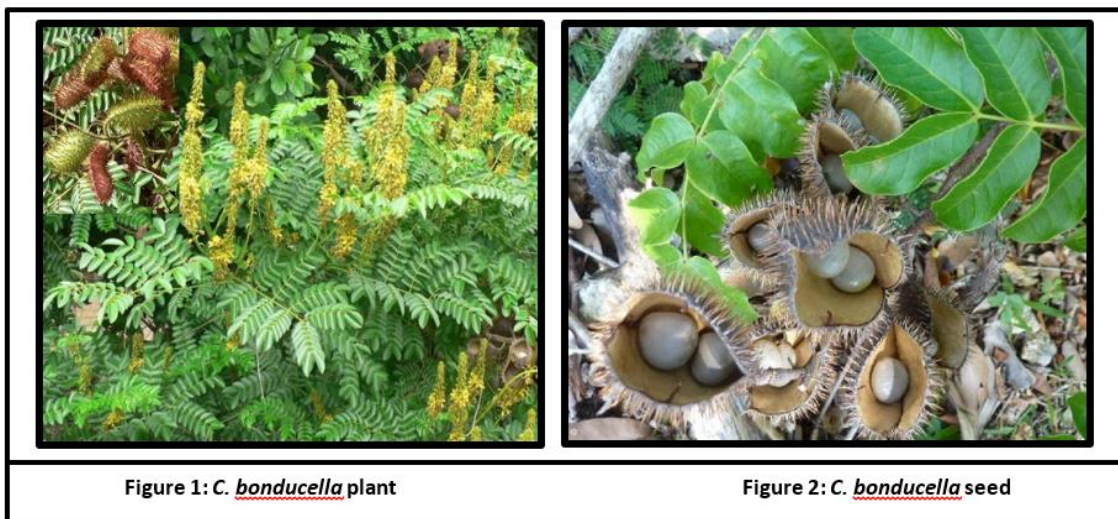
The seeds are reported to have anti-diabetic properties. The abundance of regular assets in India also, the rising number of diabetes patients will make ready for more up to date medication/subordinate treatments to deal with

the disorder.<sup>6</sup> Inflammation is regularly related with pain and includes the expansion of vascular penetrability, increment of protein denaturation and film modification. At the point when the cell undergoes damage, irritation of tissue turns into a guarded reaction described by redness, pain, heat, swelling and loss of capacity in the harmed territory. The shrub holding key to the treatment of many incurable or unmanageable ailments is at the verge of extinction due to a prolonged period of seed dormancy, overutilization of the plant parts for medicinal use and destruction of its natural habitat.

The shell is known to contain starch, fatty oil, sucrose, phytosterols, stearic, palmitic, oleic, linoceric, linolenic and a mixture of unsaturated acid. The protein and amino acid substance fluctuates.<sup>7</sup> The administration of aggravation related sicknesses is of concern and may must be tended to utilizing plant extracts.<sup>8</sup> Phytochemical analysis of powdered leaves of *C. bonducella* was carried out using extraction method.<sup>9</sup> Lotion prepared from the plant extract has also been iterated in traditional Chinese medicine to be useful in the treatment of cellulitis. In spite of having such potential to be a cornerstone for the treatment and management of a plethora of disorders, the precious plant has been overlooked by the scientific community, populace, policymakers, and bureaucracy.

The plant is also known to possess antioxidant,<sup>10</sup> antifilaria activity,<sup>11</sup> anticonvulsive activity<sup>12</sup> and anti-microbial activity,<sup>13</sup> antimalarial activity,<sup>14</sup> antitumor activity<sup>15</sup> anti-ulcer activity,<sup>16</sup> immunomodulator activity<sup>17</sup> and Anticataract activity.<sup>18</sup>



Figure 1: *C. bonducella* plantFigure 2: *C. bonducella* seed

### TAXONOMIC CLASSIFICATION

<b>Kingdom</b>	: Plantae
<b>Phylum</b>	: Magnoliophyta
<b>Division</b>	: Magnoliopsida
<b>Class</b>	: Angiospermae
<b>Order</b>	: Fabales
<b>Family</b>	: Fabaceae / Caesalpiniaceae
<b>Genus</b>	: <i>Caesalpinia</i>
<b>Species</b>	: <i>bonducella</i>

### Vernacular Name

The plant of significance, *C. bonducella*, is pronounced by different names by natives across the globe. In Hindi, the plant is known to be sagar gota, in English fever nut, bonducella nut and nicker nut, in Sanskrit valli, in Urdu akitmakit, in Bengali nata, in French bois and so forth.

### Macroscopic Characteristics

The plant, *C. bonducella* has dark grey branches it also bears prickles, which are yellow in color, hard and straight.

### Leaves

The shrub, *C. bonducella* has large sized leaves (30 to 60 centimeters long), which are very leafy and branched. The dorsal side of the leaf bears thorny petioles. The base of the leaf shows decreased pinnae with elongated mucronate point and has six to eight sets of pinnae with a couple of stipular-spines.<sup>21</sup>

### Flowers

The plant exhibits very dense blooms, which are thin at the base and thick at the top with axillary racemes. The blossoms of the plant are generally 15 to 25 centimeters in length. The plant bears short pedicles in buds, which are nearly 5 millimeters in blooms and around 8 millimeters in fruits.<sup>22</sup>

### Seeds

The seeds, which are hard coated, are greenish or grey in color and are slightly compressed on one side because of close squeezing of adjacent seed. Seeds are round, black and marked with vertical cracks. Kernels of dry seeds are found to be disconnected from the testa, which is around 1 to 1.25 millimeters thick and comprises of three layers.<sup>23</sup>

It shows hilum and micropyle shut to one another. Hilum enveloped by a dim region ordinarily with a whitish remainder to funicle. Micropyle is near the edges of a dim district. It contains a seeds coat that is dim greenish to grayish and fairly dim pale blue in nature.<sup>24</sup>

### Microscopic Characteristics

#### Seeds

On microscopically evaluation the seeds of the plant *C. bonducella* displayed many layers made up of vertical, columnar luminal cells. Cells of columnar palisade have powdery characteristics and cells of parenchyma are dark in color with thick bone molded walls and grains of starch loaded inside cells.<sup>25, 26, 27</sup>

### Traditional and Modern Uses

*C. bonducella* has been indicated in many diseases by aboriginal people around the world. The seeds have been used as a styptic and to treat conditions such as helminthiasis, colic pain, malaria, hydrocele, skin disorders, and inflammation. In Madras (Chennai) an ointment made from the powdered seeds of the plant in castor oil can effectively mitigate the symptoms of hydrocele and orchitis on external application. The oil obtained from the seeds of the plant has also been found to control bouts of convulsions and paralysis. In Guinea, the pounded seeds of the shrub are used as a vesicant. The powdered seeds when mixed with an equal part of pepper powder and given to malarial patients were found to possess feeble antiperiodic properties. But, was unable to appease the symptoms of malignant malaria.<sup>28</sup>

A paste of the ground seeds in water, when given internally, has been found to be quite effective in cases of snake bite but cannot be considered to be an antidote to snake venom. Seeds of the plant, when crushed and powdered along with long pepper and taken with honey, has been found to act as a potential expectorant. In the West Indies, the roasted seeds have been used by the natives to treat the symptoms of diabetes. Powder of the kernel of the seed along with equal parts of black pepper when taken thrice a day in a dose of 15-30 grains for adults and 3-4 grains. For children, has been found to be very useful in all cases of simple, continued and intermittent fevers. Leaves and twigs of the plant have been used traditionally to treat tumors, inflammation, liver disorders and toothache. Leaves and juices of the climber have been used traditionally to alleviate conditions such as elephantiasis and smallpox.<sup>29</sup>

### Standardization Parameters

For the standardization parameters of *C. bonducella* followed by taste, colour, odour, LOD, total ash value, acid insoluble, water in soluble, sulphated ash, extractive value in hexane, foreign matter, extractive value in ethanol, extractive value in water, extractive value in ethyl acetate, solubility in alcohol, extractive value in chloroform see table 1.<sup>31, 32, 33</sup>

**Table 1:** Physicochemical properties of *C. bonducella*

S.N O.	Parameters	Physicochemical properties
1	Taste	Astringent
2	Colour	Light brown
3	Odour	Characteristic odour
4	Foreign matter (%)	0.979
5	Loss on drying (%)	8.83
6	Tot ash (%)	3.37
7	Acid insoluble ash (%)	0.49
8	Water soluble (%)	1.69
9	Sulphated ash (%)	4.37
10	Solubility in alcohol (%)	26.8
11	Extractive value in hexane (%)	4.3
12	Extractive value in chloroform (%)	2.58
13	Extractive value in ethyl acetate (%)	0.92
14	Extractive value in ethanol (%)	2.92
15	Extractive value in water (%)	6.7

**Table 2:** Chemical component of *C. bonducella*

S. No.	Parts	Chemical constituent
1.	Seed Kernel	Phytosterols- sitosterol, heptacosane noncrystalline, bitter glycoside, bonducin, neutral saponin
2.	Seed	Neutral saponin, terpenoids, caesalpin, $\beta$ -caesalpin and $\alpha$ - caesalpin
3.	Leave	Pinitol, glucose, calcium, brazzillin
4.	Bark	Homoisoflavonoids, 6-Omethylcaesalpinianone, and caesalpinianone
5.	Root	Cassane furanoditerpene, caesalpinin, bonducellpins A, B, C, D, and diosgenin

### Phytochemistry

Various parts of the plant, *C. bonducella* such as leaves, twigs, fruits, and stem were found to be rich in diverse alkaloids.<sup>33</sup> Though various parts of the plant contain lots of phytochemicals, the kernels of seeds have been studied elaborately. Many reports suggest the presence of some alkaloids, particularly natin in the plant.<sup>34</sup> But the result was not decisive with a degree of ambiguity. Bonducin was the first non-alkaloidal phytochemical to be found in the seeds of the plant, which is a sulfur-containing compound and is a glycoside.<sup>35</sup> The chemical structure of bonducin has been recently deciphered. Seeds of the plant was found to be rich in saponin and many enzymes such as urease, amylase, peroxidase, catalase, and protease. Twigs of the plant was found to be enriched with steroidal saponin.<sup>36, 37</sup>

### Roots

The shrub showed the presence of furanodi terpene of cassane and caesalpinina. The roots also showed the presence of Bonducellpins A, B, C, D and diosgenin.<sup>38, 39, 40</sup> The ethanolic extract of the bark of the climber revealed the presence of two new homo-isoflavonoids and five more natural products.

### Leaves

*C. bonducella* leaves showed the presence of glucose, minerals such as phosphorous and calcium and pinitol. The leaves also exhibited the presence of phytochemicals brazillin and bonducin.<sup>41, 42</sup>

### Chemical component

Several valuable phytochemicals have been elicited from different parts of this plant such as the seeds have been found to contain neutral saponin, terpenoids, caesalpin,  $\beta$ -caesalpin, and  $\alpha$ - caesalpin, seed Kernels are found to contain phytosterols- sitosterol, heptacosane noncrystalline, bitter glycoside, bonducin, neutral saponin, leaves are found to have pinitol, glucose, calcium, brazzillin, bark reveals the presence of homoisoflavonoids, 6-Omethylcaesalpinianone, and caesalpinianone, roots elaborate cassane furanoditerpene, caesalpinin, bonducellpins A, B, C, D, and diosgenin see table 2.<sup>43, 44, 45</sup>



### Recent Pharmacological Studies

The presence of an array of phytochemicals in various parts of the plant prompted many pharmaceutical studies. But the plant still remains under-investigated and under-documented. More rigorous scientific investigations could reveal a deluge of unexplored phytochemicals with immense potential to harbinger new avenues and approaches in the field of clinical therapeutics.<sup>46</sup> Various scientific texts have depicted different parts of the plant to possess significant properties see table 3.

**Table 3:** Recent pharmacological studies of seeds, leaves and flowers

S.NO.	Plant part	Uses	References
1	Seeds	Anti-inflammatory	47
2	Seeds	Antimicrobial	48
3	All parts	Immunomodulator	49
4	Seeds	Hypoglycemic and antidiabetic	50
5	Flowers	Analgesic	51
6	Leaves	Antioxidative stress	52
7	Seeds	Antidepressant	53
8	Seeds	Antipyretic	54
9	Seeds	Antiasthmatic	55
10	Leaves	Hepatoprotective	56
11	Young twigs and leaves	Anticancer	57
12	Leaves	Antifeedant	58
13	Seeds	Antidiabetic	59
14	Seeds	Antibacterial and cytotoxic effects	60
15	Leaves	Nephroprotective	61
16	Seeds	Hypolipidemic	62
17	Seeds	Antiallergic and antihistaminic actions	63
18	Seeds	Antifertility	64
19	Leaves	Antiproliferative and pro-apoptotic	65
20	Leaves	Anthelmintic	66
21	Seeds	Antiulcer	67
22	Seeds	Antimycobacterial Activity	68
23	Seeds	Anticataract	69
24	Leaves	Antidiarrhoeal	70
25	Seeds	Antifilaria	71
26	Leaves	Muscle contractile activity	72
27	Leaves	Antifungal and Antispasmodic	73
28	Seeds	Anti-estrogenic activity	74
29	Seeds	Antidiuretic	75
30	Leaves	Antitumor	76
31	Seeds	Anxiolytic	77
32	Seeds	anticonvulsant	78

## CONCLUSION

*C. bonducella* is widely distributed an evergreen, deep-rooted shrub with a hard and woody stem. Leaf of this plant is ovate shaped, compound elliptical with a glossy surface and arranged alternately on either side of the branches. Several valuable phytochemicals have been elicited from different parts of this plant such as the seeds have been found to contain neutral saponin, terpenoids, caesalpin,  $\beta$ -caesalpin, and  $\alpha$ -caesalpin, seed kernels are found to contain phytosterols- sitosterol, heptacosane noncrystalline, bitter glycoside, bonducin, neutral saponin, leaves are found to have pinitol, glucose, calcium, brazzillin, bark reveals the presence of homoisoflavonoids, 6-Omethylcaesalpinianone, and caesalpinianone, roots elaborate cassane furanoditerpene, caesalpinin, bonducellpins A, B, C, D, and diosgenin. These potent and sui generis phytochemicals show diverse pharmacological properties.

The review has reiterated the fact that different parts of *C. bonducella* contain a number of active metabolites which have the potential to treat a number of ailments. It has also been observed that different parts of the plant show different pharmacological activities owing to the presence of unique bioactive metabolites. But further scientific research and documentation are required to explore all possibilities and prospects the rich plant has to offer.

The data of recent research on pharmacological study has been compiled in this review. The seeds, bark and roots of the plant showed antidiabetic, antioxidant, antihyperlipidemic, antispasmodic, immunomodulator, and antibacterial activity. The flowers of *C. bonducella* possess analgesic activity. The seed kernels of *C. bonducella* possess antimalarial activity and the leaves of *C. bonducella* possess anti-tumour, antiulcer, antifilarial activity. Although the plant is medicinally rich due to the abundance of potent phytochemicals still there is scope for further research. This wild plant is rich with medicinal importance biomarker compounds and proven with different pharmacological action but still there is scope to perform researches for developing the formulation for different diseases and disorders, this can increase the industrial value of this plant in future.

## REFERENCES

- Manikandaselvi S, Vadivel V, Brindha P. *Caesalpinia bonducella* L. A nutraceuticals plant. J. Chem. Pharm. Res. 7(12), 2015, 137-42.
- Kannur DM, Paranjpe MP, Sonavane LV, Dongre PP, Khandelwal KR. Evaluation of *Caesalpinia bonducella* seed coat extract for anti-inflammatory and analgesic. J Adv Pharm Technol Res, 3(3), 2012, 171-175.
- Kumar SR, Shastri S, Venkatesh R, Pradeepa K, Krishna V. Antibacterial potential of *Caesalpinia bonducella* extracts and their isolated phytoconstituents: In vitro and in silico analysis. Journal of Applied Biology & Biotechnology. 7(03), 2019, 41-46.
- The Wealth of India: A Dictionary of Indian Raw Materials and Industrial Products; Raw Materials and Industrial Products, Part II. In

“C.” B. N. Sastri. New Delhi, India: Council of Scientific and Industrial Research. 2, 1950-1951.

- Tummin KMC. Chemical examination of seeds of *Caesalpinia bonducella* Fiem. J Indian Chem Soc. 7, 1930, 207.
- Chopra RN, Chopra IC, Verma BS. Supplement to Glossary of Indian Medicinal Plants, Publication and Information Directorate (CSIR), New Delhi. 1969.
- Kakade R, Sirish S, Phytochemical and pharmacology review on *Caesalpinia bonducella*. Int. Res. J Pharm. 7(12), 2016, 12-17.
- Vedavyasa S, Ahamad RN. Antihyperlipidemic Effect of alcoholic seed extract of *Caesalpinia bonducella* in alloxan induced diabetic male albino rats. International Journal of Diabetic and Endocrinology. 4(1), 2015, 1-9.
- Ali A, Rao VN, Shalam MD, Gouda ST, Shantakumar SM. Anticonvulsive effect of seed extract of *Caesalpinia bonducella* (Roxb.). Iranian Journal of Pharmacology & Therapeutics. 8(2), 2009, 51-55.
- Shukla S, Mehata A, Mehata P, Vyas SP, Shukla S, Bajpai VK. Studies on antiinflammatory, antipyretic and analgesic properties of *Caesalpinia bonducella* F. seed oil in experimental animal models. Food and Chemical Toxicology. 48(1), 2012, 61-64.
- Sachan NK, Verma S, Sachan AK, Hussain A. An investigation of antioxidant activity of *Caesalpinia bonducella* seeds. Annals of Pharmacy and Pharmacological Sciences. 1(2), 2010, 88-91.
- Gaur RL, Sahoo MK, Dixit S, Fatma N, Rastogi S, Kulshreshtha DK, et al. Antifilarial activity of *Caesalpinia bonducella* against experimental filarial infection. Indian Journal of Medical Research. 128(1), 2008, 65-70.
- Ali A, Venkat Rao N, Shalam M, Shivaraj GT, Shantakumar SM. Anticonvulsive effect of seed extract of *Caesalpinia bonducella*. Iranian Journal of Pharmacology and Therapeutics. 8(2), 2009, 51-55.
- Billah MM, Islam R, Khatun H, Parvin S, Islam E, Islam SA. Antibacterial, antidiarrhoeal and cytotoxic activities of methanol extract and its fractions of *Caesalpinia bonducella* (L) Roxb leaves. J of the International Society for Complementary Med Res. 13(1), 2013, 101.
- Irshad S, Mehata A, Mehata P. Antimalarial activity of three Pakistan medicinal plants. Pak J of Pharmaceuticals Sciences. 24(4), 2011, 589-91.
- Gupta M, Mazumder UK, Kumar RS, Sivakumar T, Vamsi ML. Anti-tumor activity and antioxidant status of *Caesalpinia bonducella* against Ehrlich ascites carcinoma 2in Swiss albino mice. J of Pharmacological Science. 94(2), 2004, 177-84.
- Ansari JA, Ahmad S, Jameel M. Effect of *Caesalpinia bonducella* L. on ulcer and gastric secretions in pylorus legated rat model. Journal of Drug Delivery and Therapeutics. 2, 2012, 102-104.
- Shukla S, Mehta A, John J, Mehta P, Vyas SP, Shukla S. Studies on immunomodulatory activities of ethanolic extract of *Caesalpinia bonducella* seeds. J of Ethno. 125(2), 2009, 252-256.
- Nirmala R Kakade, Shirish S. Pingale, Manohar G. Chaskar. Phytochemical and pharmacological review of *Caesalpinia bonducella*. Int Res J of Pharmacy. 7(12), 2017, 12-17.
- Handa SS and Kaul MK. Supplement to cultivation and utilization of medicinal plants, RRL, Jammu-Tawi, 1996, 727-737.
- Gogoi S, Yadav AK. In vitro and in vivo anthelmintic effects of *Caesalpinia bonducella* (L.) Roxb. leaf extract on Hymenolepis diminuta and Syphacia obvelata. Journal of Intercultural Ethnopharmacology. 5(4), 2016, 427-433.
- Khandagale P, Abhijeet V, Yunus PN, Ansari and Patil R. Pharmacognostic, physicochemical and phytochemical



- investigation of *Caesalpinia bonducella* [L.] roxb. Seed. International Journal of Pharmacy and Biological Sciences. 8(34), 2018, 461-468.
23. Vikhe S and Nirmal S. Evaluation isolation and characterization of chemical constituents from *C. bonducella* L. seed. Pravara Journal of Science & Technology. 1(1), 2017.
  24. Kokate C.K., Practical Pharmacognosy, 4th edition, Vallabh Prakashan, Delhi, 1997, 107 -111.
  25. Khandelwal KR. Practical Pharmacognosy Techniques and Experiments. 15th edition, Nirali Prakashan, Pune, 2006, 15–163.
  26. The Wealth of India, Raw material, Ca-Ci, Revised Ed, Publication and Information Directorate, CSIR, New Delhi, 3, 1992, 6-8.
  27. Komal M, Khadabadi SS, Deokate UA and Deore AA. Report and Opinion, 2(3), 2010, 83-90.
  28. Kokate CK, Practical Pharmacognosy, 4th edition, Vallabh Prakashan, Delhi, 1997, 107 -111.
  29. Khandelwal KR, Practical Pharmacognosy Techniques and Experiments. 15th edition, Nirali Prakashan, Pune, 2006, 15–163.
  30. Wallis TE, Text Book of Pharmacognosy, 5th edition, CBS publishers and Distributors, Delhi, 2005, 104-158.
  31. Handa SS and Kaul MK, Supplement to cultivation and utilization of medicinal plants, RRL, Jammu-Tawi.J of Pharma. 1996, 727-737.
  32. Khandagale PD, Puri AV, Ansari YN and Patil RY. Pharmacognostic, physicochemical and phytochemical investigation of *Caesalpinia bonducella* [L.] Roxb Seed. Int J of Phar and Biol Sci. 8(3), 2018, 461-468.
  33. Sembiring E, Elya B, Sauriasari R. Phytochemical screening, total flavonoid and total henolic content, and antioxidant activity of different parts of *Caesalpinia bonducella* (L.) Roxb. Pharmacog J. 10(1), 2018, 123-7.
  34. Pethani S, Savaliya N and Abdul N. Phytochemical extraction and antibacterial studies of *Caesalpinia bonducella* seed extracts. Mapana J Sci. 13(4), 2014, 47-54.
  35. Peter SR, Tinto WF, Mclean S, Reynolds WF, and Yut M, Cassane Diterpens from *Caesalpinia bonducella*, Phytochemistry. 47(6), 1998, 1153-1155.
  36. Peter SR and Tinto WF. Bonducellipins A-D, new cassane furanoditerpene of *Caesaipinia bonduceila*, Journal of Natural Product. 60(12), 1997, 12-19.
  37. Jain S, Saraf S, Kharya MD and Dixit VK. First report of diosgenin from seed kernels of *Caesalpinia crista* Linn. Indian Drugs. 28(4), 1991, 202.
  38. Watt JM and Brandwijk MG. The medicinal and poisonous plants of Southern and Eastern Africa. Scientific research. 2, 1962.
  39. Raghav PK and Singh V. Comparison of the physicochemical & phytochemical screening of leave and seed of Kat-karanj (*Caesalpinia bonducella*). Int. J. Bio. Pharm. Res. 5(4), 2014, 313-322.
  40. Ghatak NG. Chemical examination of kernals of the seeds of *Caesalpinia bonducella*. Ind Aca of Sci. 4, 1934, 141.
  41. Raghav PK and Singh V. Comparison of the physicochemical & phytochemical screening of leave and seed of Kat-karanj (*Caesalpinia bonducella*). Int. J. Bio. Pharm. Res. 5(4), 2014, 313-322.
  42. Gogoi S and Yadav AK. In vitro and in vivo anthelmintic effects of *Caesalpinia bonducella* (L.) Roxb. leaf extract on hymenolepis diminuta (Cestoda) and Syphacia obvelata (Nematoda). J of Inter Ethno. 5(4), 2016, 427-433.
  43. Subbiah V, Nagaraja P, Narayan P and Nagendra HG. Evaluation of pharmacological properties of *Caesalpinia bonducella* seed and shell extract.J of Pharmacog. 11(1), 2019, 150-4.
  44. Jagdale RA, Somkuwar AP, Bhoys SK, Sarode KG and Limsay RP. In vivo anti-inflammatory activity and GC-MS analysis of hydroethanolic extract of *Caesalpinia bonducella* seeds. J of Pharmacog and Phytochem. 8(3), 2019, 929-934.
  45. Reichal C, Prathiba, Vishnpriya V, Ponnulakshmi R, Gayathri R, Madhan K, Shyamaladevi B, Manikannan M and Selvaraj J. Studies on antimicrobial activity of *Caesalpinia bonducella* seed ethanolic extract on selected human oral pathogens. Drug Invention Today. 12(4), 2019, 806-808.
  46. Fouzia K, Nida D, Mehreen L, Muhammad Y, Zulfiqar A and Ahmed M. Immunomodulatory activities of extracts of *Caesalpinia pulcherrima*. Jour of herbs, spices & medi plants. 24(3), 2018, 245-256.
  47. Jagdale RA, Somkuwar AP, Bhoys SK, Sarode KG and Limsay RP. In vivo anti-inflammatory activity and GC-MS analysis of hydroethanolic extract of *Caesalpinia bonducella* seeds. J of Pharmacog and Phyto. 8(3), 2019, 929-934.
  48. Reichal C, Prathiba, Vishnpriya V, Ponnulakshmi R, Gayathri R, Madhan K, Shyamala B, Manikannan, M and Selvaraj J. Studies on antimicrobial activity of *Caesalpinia bonducella* seed ethanolic extract on selected human oral pathogens. Drug Invention Today. 12(4), 2019, 806-808.
  49. Fouzia K, Nida D, Mehreen L, Muhammad Y, Zulfiqar A and Ahmed M. Immunomodulatory activities of extracts of *Caesalpinia pulcherrima*. Journal of Herbs, Spices & Medicinal Plants. 24(3), 2018, 245-256.
  50. Aswar P and Kuchekar B. Assessment of hypoglycemic and antidiabetic effects of *Caesalpinia bonducella* (L.) Roxb. seeds in alloxan induced diabetic rat and its phytochemical, microscopic, biochemical and histopathological evaluation. Asian J of Plant Sci and Res. 1(3), 2011, 91-102.
  51. Aruna D, Tandan S, Dinesh Kumar, Shailesh P, Dudhgaonkar and Lal J. Analgesic activity of *Caesalpinia bonducella* flower extract. Pharma Bio. 46(11), 2008, 668-672.
  52. Bharath KP, Ponnu LR, Selvaraj J, Shyamaladevi B, Madhan K, Vishnupriya V, Manikkanan M and kumar S. Antioxidative stress potentials of *Caesalpinia bonducella* in cardiac tissue of nicotine-induced experimental rats. Drug Invention Today. 12(3), 2019, 402-406.
  53. Sarma P, Borah M and Das S. Evaluation of the protective effect of ethanolic extract of seed kernel of *Caesalpinia bonducella* Flem (EECB) on forced swimming-induced chronic fatigue syndrome in mice. Phcog Res. 11, 2019, 254-259.
  54. Shukla S, Mehta and Archana. In vivo anti-inflammatory, analgesic and antipyretic activities of a medicinal plant *Caesalpinia bonducella*. F. Pak J of Pharma Sci. 28, 2015, 1517-1521.
  55. Khandagale PD and Puri AV. Evaluation of antiasthmatic activity of *Caesalpinia bonducella* [L.] Roxb. seed. J of Drug Delivery and Thera. 9(2), 2019, 144-149.
  56. Sumalatha, Bhat S, Kumar MR, Kumar N, Padma, Pai D, Ranganath SK and Choudhary S. *Caesalpinia bonducella* Linn extracts exhibit hepatoprotective effect on HepG2 cells against paracetamol by Up-regulating glutathione related genes. J of Krishna Ins of Med Sci. 8(2), 2019, 1-12.
  57. Nonso F, Ogunlana O, Ogunlana OE, Isewon I and Oyelade J. Potential anti-cancer flavonoids isolated from *Caesalpinia bonducella* young twigs and leaves. Mole Dock and In Silico studies Bioinfor and Bio Insights. 13, 2019, 1-16.
  58. Backiyaraj M, Elumalai A, Kasinathan Dhamodaran, Mathivanan T, Krishnappa, Kaliyamoorthy and Elumalai K. Bioefficacy of *Caesalpinia bonducella* extracts against tobacco cutworm, *Helicoverpa armigera* (Hub.) (Lepidoptera: Noctuidae). J of Coastal Life Medi. 3(5), 2015, 382-388.



59. Dwitasari O, Sasongko D, Seno H and Safithri M. Identification of bioactive compounds and  $\alpha$ -glucosidase inhibition activity of *Caesalpinia bonducella* seed extract. In vitro Current Biochemistry. 4(3), 2017, 1-9.
60. Sundar JS, Christobel RJ, Selvi NK, Abirami MP and Dr. Samuel S. Efficient green synthesis of silver nanoparticles from *Caesalpinia bonducella* seeds and its antibacterial and cytotoxic effects an in vitro study. Pharma Inno J. 7(11), 2018, 95-102.
61. Bharath KP, kumar S, Kayalvizhi E, Ponnu LR, Selvaraj J, Vishnupriya V, Shyamaladevi B and Madhan K. A study on the nephro protective effect of *Caesalpinia bonducella* on nicotine-induced rats. Drug Invention Today. 10, 2018, 3512-3519.
62. Sarma G and Das S. The hypolipidemic activity of ethanolic extract of seed kernel of *Caesalpinia bonducella* fleming on serum lipids and atherogenesis in albino rats fed with high fat diet. Int J of Basic & Clinical Pharmaco. 7(2), 2018, 266-272.
63. Vikhe S & Nirmal S. Antiallergic and antihistaminic actions of *Caesalpinia bonducella* seed possible role in treatment of asthma. J of Ethno. 216, 2018, 251-258.
64. Tripathy B, Swain NS, Panda MK, Pradhan RN, Acharya UR. Antispermato-genic effects of seed extract of *Caesalpinia bonducella* in Swiss mice. Int J of Biosciences. 12(4), 2018, 23-34.
65. Prakash SP, Balaji KS, Lakshmi GM, Chandrashekara KT, Jayarama S. Methanol extract of *Caesalpinia bonducella* induces apoptosis via up-regulation of bax and activation of PARP in Ehrlich ascites tumor cells. Med Aromat Plants. 5, 2016, 273.
66. Gogoi S, Yadav AK. In vitro and in vivo anthelmintic effects of *Caesalpinia bonducella* (L.) Roxb. leaf extract on *Hymenolepis diminuta* (Cestoda) and *Syphacia obvelata* (Nematoda). J of Intercultural Ethno. 5(4), 2016, 427-433.
67. Sawian O, Girish N, Zambare, Arulmozhi S and Deepali A. Bansode Effect of *Caesalpinia bonducella* extract in pylorus ligation induced ulcers in wistar rats. Scholars Research Library Der Pharmacia Lettre. 8 (4), 2016, 191-197.
68. Sonvane SM, Deshpande AN, Shaikh RA, Gadgul AB, Choutmahal SA and Bhosale PV. Evaluation of IN-VITRO antimycobacterial activity of *Caesalpinia bonducella* seed coat extracts. International Journal of Pharma Research & Review. 5(10), 2016, 7-11.
69. Kurmi P, Konwar M and Das S. In-vitro Anticataract activity of ethanolic extract of seed kernel of *Caesalpinia bonducella* (L.) Fleming on goat lens. Pharma Science Monitor. 6(1), 2015.
70. Billah MM, IslamR, Khatun H, Parvin S, Islam E, Islam SE and Ali. Antibacterial, antidiarrhoeal, and cytotoxic activities of methanol extract and its fractions of *Caesalpinia bonducella* (L.) Roxb leaves. BMC Complementary and Alternative Medi. 13, 2013, 101.
71. Gaur M, Sahoo S, Fatma N, Rastogi S, Kulshreshtha DK, Chatterjee RK & Murthy PK. Antifilarial activity of *Caesalpinia bonducella* against experimental filarial infections. Indian J Medi Res. 2008, 65-70.
72. Datte J, Traore A, Offoumou M & Ziegler A. Effects of leaf extract of *Caesalpinia bonducella* (Caesalpinaceae) on the contractile activity of uterine smooth muscle of pregnant rats. J of Ethno, 60(2), 1998, 149-155.
73. Khan, Ullah H , Ali, Khan I, Ullah A, Naz R and Gilani and Hassan A. Antibacterial, antifungal, antispasmodic and Ca antagonist effects of *Caesalpinia bonducella*, Natural Product Research. 25(4), 2019, 444-449.
74. Salunke KR, Nazeer R, Ahmed, Marigoudar SR and lilaram. Effect of graded doses of *Caesalpinia bonducella* seed extract on ovary and uterus in albino rats. J Basic Clin Physiol Pharmacol. 22(1-2), 2017, 49-53.
75. Khedkar A, Mandavkar YD, Shinde G, Khalure P and Dere P. Diuretic effect of *Caesalpinia bonducella* in rats. Bangladesh J Pharmacol. 6, 2011, 61-63.
76. Gupta M, Mazumder UK, Kumar RS, kumar TS and Vamsi ML. Antitumor activity and antioxidant status of *Caesalpinia bonducella* against ehrlich ascites carcinoma in swiss albino mice. J of Pharmacological Sci. 94, 2017, 177-184.
77. Ali A, Rao NV, Shalam M, Gouda TS, Babu J, kumar SS. Anxiolytic activity of seed extract of *Caesalpinia Bonducella* (Roxb) in laboratory animals. Internet J of Pharmacology. 5(2), 2017.
78. Ali A, Rao V, Nimmagadda, Hussain, Shalam, Gouda T and Shantakumar SM. Anticonvulsive effect of seed extract of *Caesalpinia bonducella* (Roxb.). Iranian Journal of Pharmacology and Therapeutics. 8(2), 2019, 51-55.

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