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***Caesalpinia bonducella* – A REVIEW ON PHARMACOLOGICAL AND PHYTOCHEMICAL ACTIVITY OF SEEDS**

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ABSTRACT

Many herbal remedies have been employed in various medical systems for the treatment and management of different diseases. The plant *Caesalpinia bonducella* has been used in different system of traditional medication for the treatment of diseases and ailments of human beings. The phytochemical screening of seeds of *Caesalpinia bonducella* revealed the presence of bioactive compounds such as Triterpenoids, Flavonoids, glycosides, saponins, tannins, alkaloids and amino acids. *C. bonducella* has been reported to have antidiabetic, anti-inflammatory, anti-filarial, anxiolytic, analgesic, antipyretic, immunomodulatory, hypoglycemic, antidiuretic, antiestrogenic, antimicrobial, antifungal, anticonvulsant activity. This review attempts to encompass the available literature on seeds of *Caesalpinia bonducella* with respect to its pharmacognostic characters, chemical constituents, summary of its various pharmacological activities and traditional uses. Therefore, this information will be helpful to create interest towards the plant and may be useful in developing new formulations.

KEYWORDS: *Caesalpinia bonducella*, Phytoconstituents, Pharmacological activities, Traditional uses.

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INTRODUCTION

About 8,000 herbal remedies have been codified in Ayurveda. The Rigveda (5000 BC) has recorded 67 medicinal plants, Yajurveda 81 species, Atharva veda(4500-2500 BC) 290 species, Charak Samhita (700 BC) and Sushrut Samhita (200 BC) had described properties and uses of 1100 and 1270 species respectively, in compounding of drugs and these are still used in the classical formulations, in the Ayurvedic system of medicine.¹ All components of the plant have medicinal properties so it is a valuable medicinal plant which is utilized in traditional system of medicine. Furthermore many western drugs had their origin in plant extract. There are many herbs, which are predominantly used to treat cardiovascular problems, liver disorders, central nervous system, digestive and metabolic disorders. Herbal drugs or medicinal plants, their extracts and their isolated compound(s) have demonstrated spectrum of biological activities. Ethnopharmacological studies on herbs/medicinally important plants continue to interest investigators throughout the world. However one of the impediments

in the acceptance of the Ayurvedha or Siddha formulation is the lack of standard quality control profiles.² World Health Organisation (WHO) has defined medicinal plants as plants that contain properties or compounds that can be use for therapeutic purposes or those that synthesize metabolites to produce useful drugs.³ *Caesalpinia bonducella* is an Indian herb reported in Ayurveda, the ancient Hindi medicine system of India as shown in figure 1. *Caesalpinia bonducella* belongs to the Family: Caesalpiniaceae found all over the world specially, in India, Sri Lanka and Andaman and Nicobar Islands, in India specially present in tropical regions.⁴⁻⁶ The plant was much confused with *Caesalpinia bonducella* (Syn. *C. bonduc*) and was described under the same.⁷⁻¹¹ Beside this, species like *C. nuga*⁵⁻⁹ and *C. jayoba* are also sometimes wrongly designated as synonyms for *C. crista*. In fact, *C. jayoba* is an adulterant of *C. crista*. "Bonducella" the name of the species is derived from the Arabic word "Bonduce" meaning 'a little ball' which indicated the globular shape of the seed.⁶ The seeds are known as keto, solo or kankaj. Figure 2 depicts the seeds of *Caesalpinia bonducella*.



Figure 1
Branches of *Caesalpinia bonducella* plant with Leaf and Seed⁴⁰



Figure 2
Seeds of *Caesalpinia bonducella* plant⁴¹

SYNONYMS:⁷

Tamil:	Kalarci ver, Kalarcik Koluntu, Kalarcip paruppu, Kazharchikkaai, Kalachikai, Kalichikai, Kazarci.
Hindi:	Gajga, Kañjā, Karanju, Kañtkarej, Kat-kaleji, kakaranj, Panshul, Pattil, Putik, Putikaranj.
English:	Fever nut, bonduc nut, nicker nut, nicker seed
Sanskrit:	Angarhavallari, Kantakikaranja, Kuberakshi, Latakaranja, Pattil, Puti, Raktakaranjavruksha
Urdu:	Akitmakit
Persion:	Khayahe-i-iblas
Kannada:	Gajjiga, Kiri gejjuga, Gajikekayi.
Malayalam:	Kāḷaṇci, Kazhanchi, Kazhanji, Kazhanchikkuru, Kalimarakam.
Telugu:	Mulluthige, Gaccakayai
Malay:	Gorek, Kelichi, Tinglur (Java).
Marathi:	Katukaranja, Sagargoti.
Oriya:	Gila.
Portuguese:	Noz de bonduque.
Sinhalese:	Kalu vavuletiya, Kumburu wel, Wael kumburu
Spanish:	Mate de costa, Matojo de playa, Ojo de Venado.

HABIT AND HABITAT

An armed liana, up to 15 m in height, found up to an altitude of 1,000 m in Himalaya and wild throughout the plains of India and; it is also found in deltaic region of western, eastern and southern India.⁵ Found particularly along the seacoast throughout the hotter parts of India, Burma and Sri Lanka.

PHARMACOGNOSTIC STUDIES

The Macro and microscopical features of the seed. Macroscopic Characteristics: Seed coat is hard, glossy, and greenish to ash grey in colour. It is traversed by circular and vertical faint markings of the cracks, forming uniform rectangular to squarish reticulations all over the surface, seeds 1-2, oblong, lead-colored, 1.3 cm. Long. A raised hilum with remains of the stalk lies in the centre of the dark spot, at the narrow edge of the seed. Adjacent to the hilum, lays a faint coloured circular to oval elevated micropyle. In dry seed, kernel gets detached from the testa. Testa is about 1-1.25 mm in thickness and is composed of three distinct layers, the outermost - thin and brittle, the middle one - broad, fibrous and dark - brown and the innermost - white and papery. The seed is exalbuminous. The kernel surface is furrowed and ridged, hard, pale yellowish - white, circular to oval, flattened and about 1.23- 1.75 cm. In diameter. A scar of the micropyle lies at one end of the kernel, from where arises a prominent ridge demarking the two cotyledons of the embryo. Plumule - radical axis is thick, cylindrical and straight. Taste is very bitter and odour is nauseating and unpleasant. Microscopic Characteristics: Seeds show a palisade layers which is composed of vertical, columnar, and laterally closed appressed cells. Thickenings are present on the walls of palisade cells which in tangential section appear as 6-10 denticulate projections into the lumen of cells. Then after that there is the layer of bearer cells and a thick zone of parenchymatous cells. The majority of bearer cells are T-shaped, thick walled and nonlignified. Some of the

major diagnostic microscopic characters of the powder are columnar palisade cells, bone shaped thick walled parenchymatous cells with brown content and cells filled with starch grains. The hard and shiny seeds are 1-2, oblong, upto 1.3 cm long green, turning grey.

MAJOR CHEMICAL CONSTITUENTS

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

Study yielded ten new furanocassane-type diterpenes, caesalpinins H-P and norcaesalpinin F³⁶ from seed kernels, together with 13 known diterpenes.³⁷ Seeds contain stearic, palmitic, octadeca -4, octadeca-2, lignoceric, linolenic and oleic acids. They also contain bonducellin, arginine, citrulline and aspartic acid. The seed kernels contain a-caesalpin, [3-caesalpin, γ-caesalpin, e-caesalpin⁶ and caesalpin F]. Seed kernels contain palmitic, stearic, octadeca -4-enoic and octadeca - 2, 4-dienoic, lignoceric, oleic and linolenic acids, heptacosane and sitosterol.

PHYTOCHEMICALS

The seeds of *Caesalpinia bonducella* contain major chemical constituents such as Triterpenoids, Flavonoids, glycosides, saponins, tannins, alkaloids and Amino acids.

PRELIMINARY PHYTOCHEMICAL SCREENING

The solvent extracts were subjected to routine qualitative chemical analysis to identify the nature of phytochemical constituents present in them.^{13,14}

Table 1
Phytocompounds and their properties
in *Caesalpinia bonducella*

S.No	PHYTOCOMPOUNDS	RESULTS	BIOLOGICAL PROPERTIES
1	Flavonoids	++	Antifertility, Antibiotic, Antioxidant, Antidiarrhoeal, Antimicrobial, Antiinflammatory
2	Steroids	--	Antibiotic, Antioxidant
3	Saponins	+	Anxiolytic, Anticonvulsant, Antibiotic, Antidiarrhoeal, Antimicrobial
4	Alkaloids	++++	Antidiarrhoeal, Antimicrobial
5	Tannins	+	Astringent properties, Antidiarrhoeal, Antimicrobial, Antimicrobial
6	Glycosides	----	Anxiolytic, Anticonvulsant, Antibiotic, Antimicrobial
7	Amino acids	+++	Anxiolytic, Anticonvulsant

TEST FOR FLAVONOIDS

Shinoda test

To 2 to 3ml of extract, a piece of magnesium ribbon and 1ml of concentrated HCl was added. A pink or red coloration of the solution indicated the presence of flavonoids in the drug.

Lead acetate test

To 5 ml of extract 1ml of lead acetate solution was added. Flocculent white precipitate indicated the presence of flavonoids.

TEST FOR TANNINS

Braemer's test

To a 2 to 3 ml of extract, 10% alcoholic ferric chloride solution was added. Dark blue or greenish grey

coloration of the solution indicated the presence of tannins in the drug.

TEST FOR STEROID/TERPENOID

Liebermann-Burchard test

To 1ml of extract, 1ml of chloroform, 2 to 3ml of acetic anhydride and 1 to 2 drops of concentrated Sulphuric acid are added. Dark green coloration of the solution indicated the presence of steroids and dark pink or red coloration of the solution indicated the presence of terpenoids.

TEST FOR ALKALOIDS

Draggendorf's test

A drop of extract was spotted on a small piece of pre coated TLC plate and the plate was sprayed with modified Draggendorf's reagent. Orange coloration of the spot indicated the presence of alkaloids.

Hager's test

The extract was treated with few ml of Hager's reagent. Yellow precipitation indicated the presence of alkaloids.

Wagner's test

The extract was treated with few ml of Wagner's reagent. The reddish brown precipitation indicated the presence of alkaloids.

TESTS FOR GLYCOSIDES

Legal's test

Dissolved the extract [0.1g] in pyridine [2ml], added sodium nitroprusside solution [2ml] and made alkaline with Sodium hydroxide solution. Pink to red colour solution indicates the presence of glycosides.

TEST FOR SAPONINS

Foam test

1ml of extract was dilute with 20ml of distilled water and shaken with a graduated cylinder for 15 minutes. A 1cm layer of foam formation indicates the presence of Saponins

TEST FOR AMINO ACIDS

Ninhydrin test

Dissolved a small quantity of the extract in few ml of water and added 1ml of ninhydrin reagent. Blue color indicated the presence of amino acids.

PHARMACOLOGICAL STUDIES

Although a lot of pharmacological investigations have been carried out based on the ingredients presence a lot more can still be explored, exploited and utilized. A summary of the findings of these studies is presented below.

ANTIDIABETIC / HYPOGLYCEMIC

Seed extract of *Caesalpinia bonducella* were subjected to screening of antidiabetic activity in alloxan induced hyperglycemia. The antihyperglycemic action of the extract may be due to blocking of glucose absorption. The drug has the potential to act as antidiabetic as well as antihyperlipidemic activity.¹⁵ Both the aqueous and ethanolic extracts showed potent hypoglycemic activity in chronic type 2 diabetic model. Both fractions could increase secretion of insulin from isolated islet.¹⁶ Antidiabetic study of ethanolic and aqueous extracts showed significant blood sugar lowering effect of *C. bonducella* in the type 2 diabetic model.³⁰

ADAPTOGENIC ACTIVITY

Caesalpinia bonducella seed extracts were screened for adaptogenic activity using cold stress model and swim endurance model, the seed coat as well as kernel extracts showed significant antistress activity when administered orally at a dose of 300 mg / kg b.wt.¹⁷

ANTIFILARIAL ACTIVITY

Caesalpinia bonducella seed kernel extract and fractions showed microfilaricidal, macrofilaricidal and female sterilizing efficacy against *L. sigmodontis* and microfilaricidal and female sterilizing efficacy against *B. malayi* in animal models, indicating the potential of this plant in providing a lead for new antifilarial drug development.¹⁸

ANTIESTROGENIC ACTIVITY

Alcohol seed extract of *Caesalpinia bonducella* has antiestrogenic property, possibly acting via inhibition of estrogen secretion.¹⁹

ANTIINFLAMMATORY ACTIVITY

The antiinflammatory activity was studied in rats using the formalin arthritis and granuloma pouch methods. At a dose of 250 mg/kg the extract was found to be effective in the granuloma pouch model and compared favourably with phenylbutazone. The seeds showed a 50% inhibitory activity against carrageenan-induced oedema in the rat hind paw, at an oral dose of 1000 mg/kg, when given 24 hours and 1 hour prior to carrageenan injection (IP). The activity (66.67% inhibition) was comparable to that of phenylbutazone at a dose of 100 mg/kg.²⁰

ANXIOLYTIC ACTIVITY

It has been confirmed that anxiolytic activity of seed extract of *Caesalpinia bonducella* (Roxb) present in laboratory animals.²¹

ANTIMALARIAL ACTIVITY

An ethanolic extract of the defatted seed kernels showed promising antimalarial activity when screened

using a *Plasmodium berghei*-infected mouse model by a blood schizontocidal test.³⁸

ANTIOESTROGENIC ACTIVITY

Powdered seeds of *Caesalpinia bonducella* were found to have anti-oestrogenic activity in mice and rabbits, and an antifertility action in mice and rats.³⁹

HYPOLIPIDAEMIC ACTIVITY

The aqueous extract of the seeds showed antihypercholesterolaemic and antihypertriglyceridaemic effects in streptozotocin-induced diabetic rats.

IMMUNOMODULATORY ACTIVITY

Study of the aqueous extract of *C. bonducella* seeds on cell mediated and humoral components of the immune system in rats produced an increase in hemagglutinating antibody titer and a change in delayed-type hypersensitivity suggesting that the extract could be a promising immunostimulatory agent.³¹

ANALGESIC AND ANTIPYRETIC ACTIVITY

Ethanol extract of seed kernel of *C. bonducella* was tested for antipyretic and antinociceptive activities in adult albino rats or mice. Results showed significant central analgesic activity and marked peripheral analgesic effect.³²

SPERM EFFECT

Study of graded doses of alcoholic seed extract of *C. bonducella* showed morphological changes in the sperm of albino rats. The effect can be due to general disturbances in proteins and alteration in the cauda epididymal milieu, probably due to androgen deficiency secondary to *C. bonducella* treatment.³³

DIURETIC EFFECT

Study evaluated the aqueous and methanol extracts of dried seeds for diuretic effect. Results showed significant increase in urine volume, with increased excretion of sodium and potassium.³⁴

ANTIFUNGAL EFFECT

Study of ethyl acetate and aqueous extracts of *C. bonducella* seeds exhibited high to moderate antifungal effect against *Aspergillus niger*, *Candida albicans*, *Fusarium oxysporum* and *Alternaria solani*.³⁵

TRADITIONAL AND MODERN USES:²³⁻²⁶

The seed is claimed to be styptic, purgative and anthelmintic²⁷ and cures inflammations; useful in colic,

malaria, hydrocele, skin diseases and leprosy (Yunani). In Chennai, India, an ointment is made from the powdered seeds with castor oil and applied externally in hydrocele and orchitis. The seeds are considered tonic, ferifuge, anthelmintic, antibleorrhagic, and specific in the treatment of hydrocele. The oil from the seeds is used in convulsions and paralysis. In Guinea, the powdered seeds are considered vesicant. The powdered seeds were mixed with equal part of pepper powder to malaria patients and were found to possess feeble antiperiodic properties. In malignant malaria, they did not do any good. The seeds are ground in water and given internally in snake-bite (Brihannighantaratnakara). The seeds are not an antidote to snake-venom.²⁴ Seed and long pepper powders taken with honey gives good expectorant effect. Burnt seeds with alum and burnt arecanut are a good dentifrice useful in spongy gums, gum boils, etc. In West Indies, the roasted seeds are used as anti diabetic.²² The kernel of the seed is very useful and valuable in all ordinary cases of simple, continued and intermittent fevers. The kernel powder mixed with equal parts of black pepper is taken thrice a day in a dose of 15-30 grains by adults and 3-4 grains by children. It is made official in the Indian Pharmaceutical Codex 16. The dose of the powder being 15-18 grams. It is said to produce lots of perspiration, leading to the reduction of fever. Kernel powder with sugar and goat milk gives good results in liver disorder.²⁹ Decoction of roasted kernels is used in asthma. Children unable to digest mother's milk were given the extract of the kernel or its powder along with ginger, salt and honey to get good stomachic effect. Paste prepared from kernel gives relief from boils and other such swellings. A cake made of 30 grams of powdered kernels, fried in ghee taken twice a day is a valuable remedy in cases of acute orchitis, ovaritis and scrofula. They are used for jewellery.⁶⁻¹⁰

ETHNOVETERINARY USAGE:²³⁻²⁶

The seeds, leaves and roots are used for the treatment of tachycardia, bradycardia, tuberculosis, and tympanitis, pain in the abdomen, fever, cold and cough and liver fluke in ruminants.

CONCLUSION

Seeds of Folk medicinal plants *Caesalpinia bonducella* possess several pharmacological activities like antidiabetic, anti-inflammatory, anti-filarial, anxiolytic, analgesic, antipyretic, immunomodulatory, hypoglycemic, antidiuretic, antiestrogenic, antimicrobial, antifungal, anticonvulsant activity. Hexane, ethylacetate and methanol extracts of *Caesalpinia bonducella* contain phytochemical constituents such as Triterpenoids, Flavonoids, glycosides, saponins, tannins, alkaloids and Amino acids. Despite the broad use of *Caesalpinia bonducella* in traditional medicines, very few systematic pharmacological and phytochemical studies are reported till date assessing its therapeutic properties. In this review article, effort has been taken to collect and compile the details regarding *Caesalpinia bonducella* which will be useful to the society to venture into a field of alternative systems of medicine.

REFERENCES

- Joy PP, Thomas J, Mathew S, Skaria BP. Medicinal Plants. In: Bose TK, Kabir J, Das P, Joy PP. Tropical Horticulture. Vol. 2. Calcutta: Naya Prokash. 2001;449-632.
- Bagul MS and Ragani. Phytochemical evaluation of classical formulation. A case study Indian Drugs, 2005; 42: 15-19
- Jayakrishnan BM, Nagaraja Perumal, Hashim KM. In vitro antioxidant studies and phytochemical screening on the seeds of *Caesalpinia bonduc*. European Journal of Experimental Biology: Pelagia Research Library.[Internet] 2014; Available from: <http://pelagiaresearchlibrary.com/european-journal-of-experimental-biology/vol4-iss4 /EJEB-2014-4-4-47-51.pdf>
- Wadkar GH. Phytochemical Studies and Hepatoprotective Activity of the Leaves of *Caesalpinia Bonducella* (Linn.) Flem [dissertation]. Belgaum, Karnataka KLE University; 2009.
- Kapoor LD: Hand of Ayurvedic Medicinal Plants. CRC Press, 88; November 10, 2000.
- Konan AB, Bléyé MN, Amonkan AK, Bouafou MKG, Datté JY. Why african traditional birth attendants used *Caesalpinia bonduc* leaves to facilitate childbirth in parturient women? International Journal of Pharmacy Review & Research [Internet]. 2014; 4(1):11-6. Available from: http://www.ijpr.com/File_Folder/11-16.pdf
- Abdul Jabbar, Muhammad Arfan Zaman, Zafar Iqbal, Muhammad Yaseen and Asim Shamim. Anthelmintic Activity of *Chenopodium album* (L.) and *Caesalpinia Crista* (L.) Against trichostrongylid nematodes of sheep. Journal of Ethnopharmacology [Internet]. 2007/10/8; 114(1):86-91. Available from: https://scholar.google.com.au/citations?view_op=view_citation&hl=en&user=PL1kRbIAAAAJ&citation_for_view=PL1kRbIAAAAJ:eQOLeE2rZwMC8.
- Asolkar LV., Kakkar KK. and Chakre OJ. Second Suppl. To Glossary of Indian Medicinal Plants with Active Principles, Ethnobotanical Database of Bangladesh [Internet]. PID-CSIR, New Delhi, 1992; 1(150). Available from: <http://www.ethnobotanybd.com/index.php?action=reference&rf=Asolkar>
- Kirtikar KR, Basu BD. Indian Medicinal Plants. 2nd Edt, New Delhi. International book distributors; 1975.
- Komal Moon, Khadabadi S S , Deokate UA , Deore SL. *Caesalpinia bonducella* F - An Overview. Report and Opinion. [Internet]. 2010; 2(3):83-90. (ISSN: 1553-9873). Available from http://www.sciencepub.net/report/report0203/13_2487.
- Rastogi RP , Mehrotra BN. Compendium of Indian Medicinal Plants. New Delhi: Central Drug Research Institute and Publications & Information Directorate; 1990
- Elizabeth, M. Williamson. Major Herbs of Ayurveda. New York: Churchill Livingstone; 2002.
- Harborne JB. Phytochemical Methods - A Guide to Modern Techniques of Plant Analysis. Netherlands: Springer [Internet]. 1998; 182-190. Available from: <http://www.springer.com/gp/book/9780412572609>
- Manisha Modak et al., Indian herbs and herbal drugs used for the treatment of diabetes- recent advances in Indian Herbal Drug Research. J.Clin.Biochem.Nutr [Internet]. May 2007; 4:163-173. Available from https://www.jstage.jst.go.jp/article/jcbrn/40/3/40_3_163/_pdf
- Kannur DM, Hukkeri VI, Akki KS. Antidiabetic activity of *Caesalpinia bonducella* seed extracts in rats. Fitoterapia [Internet] Dec 2006; 77(7-8):546-549. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/16905279>
- Chakrabarti S et al., Antidiabetic activity of *Caesalpinia bonducella* F. In chronic type 2 diabetic model in Long-Evans rats and evaluation of insulin secretagogue property of its fractions on isolated islets. J Ethnopharmacol. [Internet]. 2005 Feb 10; 117-22. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/15652285>. DOI:10.1016/j.jep.2004.10.025
- Kannur DM, Hukkeri VI, Akki KS. Adaptogenic activity of *Caesalpinia bonduc* seed extracts in rats. Journal of Ethnopharmacol [Internet]. 6 Dec 2006; 108(3):327-331. Available from: <https://www.scopus.com/record/DOI:10.1016/j.jep.2006.05.013>
- Gaur RL et al., Antifilarial activity of *Caesalpinia bonducella* against experimental filarial infections. Indian J Med Res [Internet]. 2008 Jul; 128(1):65-70. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/18820361>
- Salunke, Kanchan R, Nazeer AR, Marigoudar, Shambanagouda R. L. J Basic and Clinical Physiology and Pharmacology. Journal of Basic and Clinical Physiology and Pharmacology [Internet]. 2011 Jun 1; 22(1-2):49-9. Available from: https://scholar.google.co.in/citations?view_op=view_citation&hl=en&user=Qwp3abMAAAAJ&citation_for_view=Qwp3abMAAAAJ:d1gkVwhDpl0C
- Shukla S, Mehta A, Mehta P, Vyas SP, Shukla S, Bajpai VK. Studies on anti-inflammatory, antipyretic and analgesic properties of *Caesalpinia bonducella* F. seed oil in experimental animal models. Food Chem Toxicol [Internet]. 2010 Jan; 48(1):61-4. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/19766160>
- Lilaram, Nazeer Ahmed R. Effect of ethanolic seed extract of *Caesalpinia bonducella* pregnant female albino rats. Asian Pacific Journal of Reproduction [Internet]. June 2013; 2(2): 85-8. Available from <http://www.sciencedirect.com/science/article/pii/S>

- 2305050013601244doi:10.1016/S2305-0500(13)60124-4
22. Krishnan Marg K S. The Wealth Of India Raw material series. volume 3 (ca-ci). New Delhi: CSIR; 1992.
 23. Suryawanshi H.P., Patel M.R. Traditional uses Medicinal and phytopharmacological properties of caesalpinia crista linn.- An overview. International journal of research in pharmacy and chemistry[Internet].2011;1(4): Available from: <http://www.ijrpc.com/files/000054.pdf>
 24. Khan Nazeerullah, Kumar Sunil, Singh Rishi, Dhankhar Neelam. A Pharmacognostic and Pharmacological Overview on Caesalpinia bonducella. Research Journal of Pharmaceutical, Biological and Chemical Science[Internet]. Mar 2012;3(1):480. Available from: [http://www.rjpbcs.com/pdf/2012_3\(1\)/59.pdf](http://www.rjpbcs.com/pdf/2012_3(1)/59.pdf)
 25. Gustavo J Martínez, María C Luján. Medicinal plants used for traditional veterinary in the Sierras de Córdoba (Argentina): An ethnobotanical comparison with human medicinal uses. J Ethnobiol Ethnomed. [Internet]. 2011 Aug 4;7:23. Available from: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3163512/>. doi: 10.1186/1746-4269-7-23
 26. Inder Kumar Makhija, Devang Khamar . Anti-snake venom properties of medicinal plants. Scholars Research Library. [Internet]. 2010; 2(5): 399-411. Available from: <http://scholarsresearchlibrary.com/DPL-vol2-iss5/DPL-2010-2-5-399-411.pdf>
 27. Vibha singh, Pramod K.Raghav. Review on pharmacological properties of caesalpinia bonduc L. Int. J. Med. Arom. Plants[Internet]. 2012 sep;2(3):514-530. Available from: http://openaccessscience.com/pdf-files/vol2_3_sept2012/IJMAP_2_3_21-caesalpinia_bonduc.pdf
 28. Mukesh Kumar Singh, Kushagra Nagori, Tripathi DK. Potential Analgesic & Anti-Pyretic Herbal drugs: A Comparative Review of Marketed Products. International Journal of Phytomedicine[Internet]. 2, 2010;197-209. Available from: <http://www.arjournals.org/ijop.html>.
 29. Khan SS., Chaghtai SA. and Oommachan M., Medicinal plants of Rubiaceae of Bhopal. An Ethnobotanical study. Bhopal: J. Sci. Res; 1984;6:37-9.
 30. Shrabana Chakrabarti et al .,Advanced studies on the hypoglycemic effect of Caesalpinia bonducella F. in type 1 and 2 diabetes in Long Evans rats .Journal of Ethnopharmacology, [Internet]. January 2003;84(1):41-46. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/12499075> doi:10.1016/S0378-8741(02)00262-3
 31. Shukla Shruti et al., In vivo immunomodulatory activities of the aqueous extract of bonduc nut Caesalpinia bonducella seeds. Pharmaceutical Biology.taylor and francisco online [Internet]. February 2010;48(2):227-230. Available from: <http://www.tandfonline.com/action/showCitFormats?doi=10.3109%2F13880200903085474>
 32. Archana P, Tandan SK, Chandra S, Lal J. Antipyretic and analgesic activities of Caesalpinia bonducella seed kernel extract. Phytother Res[Internet]. 2005 May;19(5):376-81. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/16106383>
 33. Peerzade N, Nazeer Ahmed R, Marigoudar S R. Morphological changes induced by Caesalpinia bonducella seed extract on rat sperm: scanning electrone microscope study. Journal of Basic and Clinical Physiology and Pharmacology. [Internet]. March 2011;20(4),309–318. Available from: DOI: 10.1515/JBCPP.2009.20.4.309.
 34. Ajay Khedkar, Yuvaraj D Mandavkar, Gulab Shinde, Pallavi Khalure and Pravin Dere. Diuretic effect of Caesalpinia bonduc in rats, Bangladesh J Pharmacol [Internet]. 2011;6:61-63. Available from:<http://www.banglajol.info/index.php/BJP/article/viewFile/8487/6425>.
 35. Shruti Shukla et al., Preliminary phytochemical and antifungal screening of various organic extracts of Caesalpinia bonducella seeds, Romanian Biotechnological Letters[Internet].2011 Jul;16:4. Available from: <http://www.rombio.eu/rbl4vol16/13%20Vivek%20Bajpai.pdf>
 36. Aruna Devi R et al., Analgesic Activity of Caesalpinia bonducella Flower Extract. Pharmaceutical Biology.taylor and francisco online [internet]. 2008;46(10-11):668-67. Available from: <http://www.tandfonline.com/doi/full/10.1080/13880200802215776>
 37. Awale et al., Constituents of Caesalpinia crista from Indonesia. Chem Pharm Bull (Tokyo)[Internet]. 2006Feb;54(2):213-8. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/16462066>
 38. Zanin et al., The genus Caesalpinia L. (Caesalpiniaceae): phytochemical and pharmacological characteristics. Molecules[Internet]. 29 June 2012;17(7):7887-7902. Available from: <http://www.mdpi.com/1420-3049/17/7/7887>. doi:10.3390/molecules17077887
 39. Monika Sharma, Jyoti Khanna, Janardhan Singh. Plants and phytochemicals as potential source of antimalarial drugs. European Journal of Biomedical and Pharmaceutical sciences[Internet]. 2016;3(5):402-408. Available from: file:///C:/Users/Admin/Downloads/article_ejbbs_volume_3_may_issue_5-1461930787.pdf
 40. Tips curing disease [Internet].Bonduc (Caesalpinia Bonduc) Overview,Health Benefits, Side effects. Availabl from: <http://www.tipdisease.com/2016/03/bonduc-caesalpinia-bonduc-overview.html>
 41. Mina herbs. [Internet]. Caesalpinia Seeds. Member since 2011, India. Available from: <http://www.exportersindia.com/minaherbs/caesalpinia-bonducella-seeds-vellore-india-196899.htm>