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Caesalpinia bonducella: A medicinal potential value

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Abstract

The herbal medicines play an authoritative protagonist in the welfare outline of people over the world. In medication, healing plants are used in captivating illnesses of an individual as well as likely source to retain up great healthy individual. *Caesalpinia bonduc* is one of the pan steamy leguminous scandent plants which is a very prevalent source of medication since the olden period by the resident people and is deliberated by several workers for their scientific applications. *Caesalpinia bonducella* is well-ordered under the cluster of Caesalpiniaceae. It is then called *C. bonducella* Flem and *C. crista* Linn. Usually, it is called Fever Nut, Bonduc Nut and Nicker Nut too. The plant is disseminated in Bangladesh, Srilanka, Myanmar, Vietnam and China 8 also available in the tropical and the subtropical sections of Asia. Entire plant of *Caesalpinia bonduc* contain all main chemical constituents for example, Isoflavones, Steroidal Saponin, Fatty Acids, Hydrocarbons, Amino Acids, Phenolics, and Phytosterols. The aim of the current survey is too high lightened the chemical constituents and the therapeutic and pharmacological application of *Caesalpinia bonduc*.

Keywords: *Caesalpinia bonducella*, medicinal, potential value

Introduction

The herbal medicines play an authoritative protagonist in the welfare outline of people over the world. In medication, healing plants are used in captivating illnesses of an individual as well as likely source to retain up great healthy individual. It is obligatory to understand the specific constituents in the plant medications which are convincing in the varied treatments. Frequent substantiations are showing the consequence of herbal plants applied in the characteristic traditional outlines^[1]. It is understood that numerous curative plants are applied to fix illnesses like stomach related problems, cardiovascular diseases, metabolic problems, liver disorders and the disorders of central nervous systems^[2]. The healing plants are active in a share of the treatments traditionally. Phytochemicals are dynamic for the assurance of plants just as an assurance of people from different diseases^[3]. At the maximum 5% of the 300,000 types of herbs worldwide have been inspected experimentally for their medicinal use. It is observed by the experts that the developing nations depend upon the medicinal plants to solved the illnesses especially in the district where there is the nonappearance of hospitals^[4]. *Caesalpinia bonduc* is one of the pan steamy leguminous scandent plants which is a very prevalent source of medication since the olden period by the resident people and is deliberated by several workers for their scientific applications. *Caesalpinia bonducella* is well-ordered under the cluster of Caesalpiniaceae. It is then called *C. bonducella* Flem and *C. crista* Linn. Usually, it is called Fever Nut, Bonduc Nut and Nicker Nut too^[5]. In a traditional classification of Indian, i.e Ayurveda, *Caesalpinia bonducella* (roxb.) is mostly applied for its antimalarial anthelmintic, calming, antiperiodic, antipyretic, and additionally for numerous infections like spasms, paralysis, leprosy, skin ailments, hydrocele, orchitis, and analogical nervous grumbles. It moreover defined to have an antioxidant, antitumor, antibacterial, and antidiabetic effect^[6]. It is appreciated to set up the moisturizer for the healing of agony type cellulitis in Chinese customary medicines^[7]. The aim of the current survey is too high lightened the chemical constituents and the therapeutic and Pharmacol+ogical application of *Caesalpinia bonduc*.

Synonyms^[2, 5]

English: Nicker Nut, Nicker Seed, Fever Nut, Bonduc Nut,

Sanskrit Name: Prakiriyā, Varini, Krakachika Vitapakarānjā, Kakachika, Valli, Kantakikarānjā, Tinagachhika, Karānjā Tirini, Kantakini, Putikarānjah, Lataakarānjā, and Karānjin.

Hindi: Kantikarānjā, Sagar Gota, Kantkarej.

Marathi: Gajaga. Unani: Karānjwāa.

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Kannada: Kiri gajjuga, gajjga, Gajjekayi.

Urdu: Aktimakit.

Telugu: Gaccakayai, Mullathige.

Tamil Name: Kazarci, Kalarciver, Kalarcip paruppu,

Geological Distribution

The plant is disseminated in Bangladesh, Srilanka, Myanmar, Vietnam and China [8] also available in the tropical and the subtropical sections of Asia [9]. It is equally found in Nicobar Andaman Islands, and in India particularly in the tropical area [2].

Useful part of the plant: Seeds, nuts, leaves, root, stem, and bark, are applicable for therapeutic purpose.

Phytoconstituents present

Entire plant of *Caesalpinia bonduc* contain all main chemical constituents for example, Isoflavones, Steroidal Saponin, Fatty Acids, Hydrocarbons, Amino Acids, Phenolics, and Phytosterols.

Traditional and modern uses

The root-bark is beneficial for tumors and for emptying the placenta afterward birth of child [14]. Root bark has numerous features like intestinal worms, febrifuge, cough, anthelmintic and amenorrhoea and so on. In Jamaica, it is applied as rubefacient and as a local claim for wounds. Twigs and leaves are usually applied for the treatment of liver, inflammation and tumors problem. They have furthermore been utilized for toothache. Leaves and juice of leaves have been used customarily for smallpox and elephantiasis.

The seed kernel is very obliging and significant in every single common example of basic, continued and uneven fevers. The kernel powder mixed with a equilibrium amount of dark pepper is administered thrice daily in a portion of 15-30 grains by adults and 3-4 grains by offspring. It was prepared authority in the Indian Pharmaceutical Codex 16 the share of the powder being 15-18 grains. It is supposed to bring lot of sweat, encouragement the reduction of fever. Sugar and Kernel powder with goat milk gives countless results in disorders of liver [17]. Roasted kernels Extract exploited in asthma. Kids incapable to process mother's milk were specified the distillate of the kernel powder or kernels together with ginger, nectar, and salt to get great impact as a stomachic. Kernel paste gives alleviation from swellings and boils. The seed is claimed to be anthelmintic laxative, styptic, and used for irritations, valuable in hydrocele, colic, malaria, leprosy and skin diseases. An ointment used to in Chennai by using the castor oil with seeds powdered applied externally in orchitis and hydrocele [10-13]. The seeds are regarded as febrifuge, tonic, antibleorrhagic, and anthelmintic obvious in the rehabilitation of hydrocele. The seeds oil is applied in paralysis and convulsions. In Guinea, the beat seeds are used as vesicant. The seeds powder is blended with equal part of pepper powder to patients of malaria and were originate to have weak antiperiodic activity. The seeds are crushed in water and consumed internally in snake-bite. The seeds are not applicable as snake-venom an anti-dote [14-15]. For expectorant impact seen long pepper powders, seed and taken with honey. For decent dentifrice effect alum Consumed with seeds and consumed arecanut are a helpful in gum boils, elastic gums, and so on. In West Indies, in diabetic patient cooked seeds are used [10, 16]. A cake prepared by using kernels powder and thirty grains, seared in ghee administered two times every day showed significant cure in cases of ovaritis,

scrofula and acute orchitis. Root in La Reunion and Madagascar, the roots are viewed as anthelmintic and febrifuge they are typically applied as an astringent in blennorrhagia and leucorrhoea [10, 12, 13, 16, 18]. In Guinea, in fever a decoction of the root is suggested.

Pharmacological studies

In spite of the detail that a countless pact of pharmacological examinations have been accomplished founded on the ingredients incidence a pointedly more can even now be studied, exploited and used. An outline of the discoveries of this research is presented below.

Antiviral activity

A root and stem ethanolic extract showed activity against *Vaccinia virus* [27]. Leaf aqueous extract showed potential on amyloidogenic/Alzheimer's disease. Study exhibited aqueous extract of leaf could constrain the Abeta aggregation from monomers and oligomers and disintegrate preformed fibrils [28].

Adaptogenic activity

By use of cold stress and swim endurance model researchers showed seed extracts of *Caesalpinia bonduc* having adaptogenic activity of in rats. It proved that significantly increased the swim endurance time by extract. Hypoglycaemia as well as enervation in serum cortisol level and expanded leukocyte count, showed by Stress induced animals by administration of extracts and also reducing significantly in defeating these imbalances [29]. Anti-hepatotoxic activity

At a dose 500mg/kg *Caesalpinia bonduc* showed antihepatotoxic recuperated the harmed liver to ordinary after 24 hrs. The possible antihepatotoxic mechanism of *Caesalpinia bonduc* has not been described so far. It is putative that the effect of *Caesalpinia bonduc* extract on liver protection is recognized with free radical suppressing activity as well as glutathione-interceded detoxification [30]. *C. bonduc* extract enhances the glutathione concentration in liver and blood glutathione and in Na + K + ATPase movement fundamentally liver when compared with its paracetamol treated control group.

Enhanced levels of serum bilirubin AST, ALT, and, ALP decreased by *C. bonduc* extract the appear to offer the defense and keep up the functional veracity of hepatic cells. *C. bonduc* extract shown protection against Paracetamol induced liver injury. *Caesalpinia bonduc* has hepatoprotective agent [31].

Anticataract Activity

In prevention or decreasing the progress of cataract seed kernels extract of *Caesalpinia bonducella*. (L) Shows significant activity. *Caesalpinia bonducella*. (L) Has antioxidant and anticataract activities, which might be useful to prevent or lessening the progress of cataract. The extract decreased opacity and tissue malondehyde (MDA) level and increases catalase and superoxide dismutase (SOD) activities. There was surge in water soluble protein levels and total proteins [32].

Antioxidant activity

The ethanolic extract of *C. bonducella* seeds consisting of phenolic constituents and were prepared for inhibitory, quenching free radicals to terminate the radical chain reaction, and acting as reducing agents [19]. The latent antioxidant activity was established by DPPH for ethanolic *Caesalpinia*

bonduc leaf extract. The results evidence that the antioxidant activity may enhance to the cytotoxic nature of the plant which may be the future study to be conduct^[20]. *Caesalpinia bonducella* seeds Chloroform extract shows antioxidant activity^[21]. *C. bonduc* leaves and twigs extract contains the phenolic compounds could be foremost contributors to its antioxidant activity. The *C. bonduc* leaves and twigs ethanolic extract has significant peroxidase and catalase activity. It is therefore recommended that it has capacity as an antioxidant properties comparable to known standards^[22].

Antiproliferative activity

Compound isolated from *Caesalpinia bonduc* cassane diterpenes were checked for their antiproliferative activity against MCF-7 (breast adenocarcinoma), DU145 (prostate carcinoma), C33A (Cervical carcinoma) and Vero (African green monkey kidney fibroblast) cells shows active^[23].

Anticancer

When *Caesalpinia bonduc* is compared with previously established anti-cancer drugs, the binding energy was extremely analogous as well as protein interaction. They additional own good ADMET characteristics, representing phytochemical isolates can equally be observed as safe and thus be further established into active commercial anti-cancer drugs^[24]. *C. bonducella* leaves methanol extract was evaluated for the antitumor activity in Ehrlich ascites carcinoma (EAC) - compartment Swiss albino mice. It instigated noticeable decrease in the packed cell volume, volume of tumor and viable cell count and it protracted the life of EAC- tumor affected mice. It is surveyed that CBME plays very noteworthy role as antitumor and antioxidant activity in EAC- affected mice^[25].

Apoptosis

Caesalpinia bonducella methanolic extract (CBME) at a dose of 200 mg/kg concentration showed decrease in the entire % of viable EAT cells (51.6 percent and ascites volume (65 percent) in CBME treated mice. CBME prolonged the rate of apoptosis with gradual number of cells showing characteristic properties, for example, apoptotic body, development membrane blebbing and fragmented DNA which was apparent by Giemsa and Acridine orange/Ethidium bromide (AO/EB) staining. Also, the mice show increase in survival time after CBME treatment. In addition, FACS statistics recommends that death of CBME treated EAT cells was for the reason that of apoptosis and not because of necrosis. In addition, the examination for molecular mechanism exposed CBME reduced the level of apoptotic Bcl-2 expression while growing pro-apoptotic Bax level. These outcomes confirm the pro-apoptotic and antiproliferative activity of CBME^[26].

Pain-relieving and Anti-inflammatory Action

Caesalpinia bonduc seed coat extract (CBSCE) at different doses orally produces consistent anti-inflammatory and antinociceptive influences in various models of inflammation and torment. Due to Presence of triterpenoidal moieties in CBSCE may be shown action of anti-inflammatory. Proposition that CBSCE has solid marginal antinociceptive activity^[33]. The impression was dose-dependent at 30 and 100 mg flower extract of *Caesalpinia bonduc* (CBFE). At 300 mg/kg level, CBFE proved significant reduction in granuloma weight show suppression of proliferative stage by extract.³⁵ Aqueous extract of *Caesalpinia bonducella* exercises analgesic influence like nonsteroidal anti-inflammatory drugs.

Aqueous extract of *Caesalpinia bonducella* shows anti-nociceptive action shows on hot plate and acetic acid prompted squirming test may own peripherally and centrally mediated anti-nociceptive properties^[34].

Antipyretic activity

Seed kernel extract of *Caesalpinia bonducella* proved noticeable antipyretic action against Brewer's yeast-initiated pyrexia in rats. The extract had good central analgesic action in tail flick and hot plate methods. In decisive, the study recommended that the seed kernel ethanolic extract of *Caesalpinia bonducella* has strong antinociceptive and antipyretic activities and thus, supports its application in the treatment of pain and pyretic disorders^[36]. *C. bonducella* seed oil is used as an antipyretic agent^[37].

Antibacterial & antimicrobial activity

C. bonducella leaves extracted with various solvents like petroleum ether, chloroform, ethyl acetic acid methanol conducted by using disc diffusion technique. Out of all extract chloroform extract shown promising antimicrobial activity at all concentration tested namely (300, 500, and 800 µg/disc) against almost all bacteria. Antibacterial activity is shown descending pet ether, ethyl acetic acid followed lowest by methanol^[38]. Seed extracts of *Caesalpinia bonducella* proved significant antibacterial activity with low MIC values^[39]. Simin *et al.* Has proved Antimicrobial action of bondenolide and seed separates from *Caesalpinia bonduc* (L.) Roxb. Diterpene bondenolide isolated from methyl extract along with ethyl acetate and methanol extract shown antifungal and antibacterial action alongside a phytotoxicity trial when assayed^[40] all outcome of antimicrobial activities conducted emphasis that potentially good sources of bioactive secondary metabolite for the development of antibiotics with broad spectrum^[41].

Antifungal Activity

Seed of *C. bonducella* extracted with aqueous and ethyl acetic acid shows moderate antifungal activity against *Aspergillus niger*, *Fusarium oxysporum*, *Alternaria solani*, and *Candida albicans*. It specifies *C. bonducella* hold a possible to control important fungal pathogens. It might be because of the presence of a number of bioactive molecules that include oils, sterols, glycosides, saponins, phenols, resins, tannins, alkaloids and flavonoids in seeds of *C. bonducella*^[42].

Antipsoriatic activity

Plant has certainly antipsoriatic action which is in correspondence with its traditional use. CBHAW (water fraction of *Caesalpinia bonduc* hydroalcoholic extract) is the chief portion that confirmed great activity in the mouse tail experimentation, lipoxygenase inhibition assay and antiproliferant action^[43]. *Caesalpinia bonduc* leaves are utilized in psoriasis treatment at Malabar locale by traditional siddha heale^[44].

Anthelmintic activity

Stem bark petroleum ether, ethanol and chloroform extract of *C. bonduc* showed promising anthelmintic action on *Pheretima posthuma* dependent on dosage manner as compared towards control and standard drug. Mechanism action proposed by researcher that extract is killing earthworm and effectively paralyzing it^[45]. Jabbar *et al.* has foremost conveyed anthelmintic action in *Caesalpinia bonducella* by both in-vivo and in-vitro, they validate their

application in the conventional Pakistan medicinal system^[46]. Leaves of *C. bonducella* showed anthelmintic action against *Phertima Posthuma* and *ascardia galli* at different concentration used for bioassay. Anthelmintic activity shown by both extract promisingly^[47].

Larvicidal activity

Saravanan KS, *et al.*, testified various concentrate of fixed oil and leaves from the *Caesalpinia bonduc* (L) Roxb. Seeds for mosquito larvicidal properties Firstly petroleum ether, aqueous extract and ethanolic extract of seed fixed oil and leaves of the *C. Bonduc* (L). Roxb tested at various concentration against the larvae (4th 100instar) culex quinquefasciatus as per rules of WHO. Results shows 100% mortality at pet.ether and ethanolic 1% concentration of leaves and 2.5% of aqueous concentration shows about 55% mortality rate and fixed oil at 2.5% concentrate shows about 92.6% mortality. The researchers suggest to chief constituent should be isolate for promising larvicidal agent may be economical and ecofriendly with non-pollutant property^[48].

Antifilarial activity

Seed part of *C. bonducella* L. proved female-sterilizing adequacy microfilaricidal, and macrofilaricidal counter to female-sterilizing viability against microfilaricidal and sigmodontis of *B. malayi* in animal method, affectionate the ability of this plant in generous a lead to novel antifilarial tranquilize development^[49].

Antimalarial Activity

Caesalpinia bonducella seeds hot ethanol, Cold ethanol, and aqueous extracts disclosed 76% 65% and 56%, growth inhibition of *Plasmodium falciparum* activity individually. It also shown supportive antimalarial activity of *C. bonducella*^[50]. Furano diterpenoids Cassane (1-3) three novels with known cassane diterpenes were effectively secluded from the *Caesalpinia bonduc* kernels of seed. Compounds 1-3 uncovered great antimalarial action against K1 strain one of the multidrug resistant *plasmodium falciparum* species^[51] CbTI- 2 was exceedingly poisonous towards the merozoites of *P. falciparum* erythrocytic attack and deprived of these activities in a concentration dependent manner. The damaging activity of CbTI- 2 on growth and development of *P. falciparum* was moreover deceptive^[52].

Antifeedant activity

C. bonduc ethyl acetic acid, hexane and chloroform extracts of exhibited antifeedant action dependent on concentration manner^[53] In India assaults and Polyphagous pest namely noctuid *Helicoverpa armigera* (Hubner) is affecting more than 200 crop species. Seed extracts of *Caesalpinia crista* were discovered in the activity against *Helicoverpa armigera* (Hubner). Commanding antifeedant and development disruption action shown by extracts. In various extract least activity shown by aqueous than butanol, ethyl acetate, followed by hexane and maximum activity shown by methanolic extract^[54].

Antidiarrhoeal activity

At a dose of 400 mg/kg of the *C. bonducella* leaves extracts mainly methanolic, chloroform, ethyl acetic acid and petroleum ether extract shows inhibit diarrhoea induced by castor oil in dose dependent manner in rats^[55].

Anti- ulcer Activity

Antisecretory and ulcer healing activity shown by *C. bonducella* aqueous extract. This plant having scope to treat disorders of gastric. The extract also strikingly reduced the free, total acidity and gastric volume and elevated the pH of the gastric fluid. The aqueous extract of CBD shows presence of alkaloid, triterpenes, flavonoid, steroids, saponins and tannins. Mainly anti-ulcer activity shown because of flavonoids. The methanolic extract of leaves *C. bonducella* (Linn.) Flem. have significant anti- ulcer activity^[56].

Antispasmodic activity

Khan HU, *et al.*, showed antispasmodic, antifungal and antibacterial, *Caesalpinia bonducella* of Ca⁺⁺ antagonist effects^[57].

Anticonvulsant activity

Researchers shown significant anti- convulsive activity of *Caesalpinia bonduc* pet. Ether extract (CBPEE) at dosage of 800 & 600mg/kg it shows increased onset time of seizures and decreased duration of tonic-clonic seizures. CBPEE at 600 and 800mg/kg had delayed the commencement of clonus seizures and reduced the duration of tonic extensor phase and obtainable a quantity-dependent defense and exhibited noteworthy anticonvulsant activity. The anticonvulsant activity produced by CBPEE strength be complete destruction of the action of strychnine on glycine inhibitory mechanisms. Anticonvulsant effect conveyed on mice^[58].

Anxiolytic activities

CBPEE dependent on dosage manner mainly 400. 600 and 800 mg/kg in stair case model showed dose dependent anxiolytic activity by enhancing the quantity of steps scaled with no wonderful effect on rearings by all doses. Also, in EPM test 600 and 800mg/kg showed significantly enhancing both the number of accesses and time spent in open arms and reduced in number of entries and time spent in the shut arms. In another hole board model of anxiolytic activity 600 and 800 mg/kg of CBPEE had significantly enhancing the latency, number and time of head dipping but not the rearing. Finally 800mg/kg dose of CBPEE shows significant anxiolytic activity by increasing number of crossings in light compartment, time spent and lessened the time consumed in dull compartment and lessened the quantity of rearings in both dim and light compartments. In another OFT models, 600 and 800mg/kg had meaningfully augmented absolute motion, number of grooming central locomotion, yet the motionlessness time has certainly condensed^[59].

Neuroprotective activity

Neuroprotective activity shown by aqueous and methanolic extract of *Caesalpinia bonducella* (Roxb) significantly in this vitamin E is used as standard drug. Various solvent extracts of the *Caesalpinia bonducella* (Roxb) exerts significantly shown antioxidant activity due to probable multiple effects relatively significant defense against the oxidative damage, which is strength attributed to its defensive activity on lipid peroxidation and resistance adding to the assurance against oxidative damage^[60].

Nootropic Activity

Extract of dried *Caesalpinia crista* seed kernels Shown potent activity on learning and memory. Aqueous extract of *Caesalpinia crista* dried seed kernels shown amnesic result of scopolamine as a ameliorated in mice. Using the Morris

water maze and radial arm maze example as the exteroceptive behavioral models, dried seed kernels aqueous extract of *Caesalpinia crista* Linn. By using piracetam as a standard drug in scopolamine induced amnesia in mice. Morris water maze model for learning and memory and radial arm maze model for learning and memory retaining was carried by using Statical analysis^[61].

Hepatoprotective activity

The animals treated with hydro alcoholic concentrate of *Caesalpinia bonducella* leaves demonstrated liver security against the toxicant as apparent by the presence of ordinary hepatic cords, nonappearance of necrosis and lesser fatty invasion. The hydro alcoholic extract is a good herbal hepatoprotective agent. The conceivable explanation behind this action might be the presence of flavonoid and phenolic compounds as secondary metabolites in the leaf extract^[62]. The co-administration of CB extract and CCl₄ significantly improved the condition by decreasing the serum AST, ALT, ALP, bilirubin and total protein significantly in preventive and curative groups respectively. This indicates the effectiveness of the CB in maintaining the structural and functional integrity of the hepatocellular components. The histopathological findings likewise propose that the treatment with CB extract can restore the liver architecture in CCl₄ induced liver cirrhosis in rats. CCl₄ induced fatty degeneration; necrosis and fibrosis of liver can be prevented /repaired by administration of CB^[63].

Hypolipidemic activity

Caesalpinia bonducella seed kernel ethanolic concentrate by means of higher fat diet exhibited significant except HDL decrease in all the lipid parameters. The lipid lowering activity of the extract might be because of the presence of triterpenoids, polyphenols, flavonoids and saponins in it. Sitosterol, constituent of seed kernel of *Caesalpinia bonducella*, has been conveyed to possess hypocholesterolemic action by intestinal cholesterol absorption inhibited and hastening the cholesterol catabolism to bile acid. The extract inhibited the gain in body weight probably by restoring the composition of the gut microflora and thereby inhibiting hepatic lipogenesis and lipoprotein lipase activity^[64].

Anticancer activity

The *Caesalpinia bonducella* (Caesalpinaceae) leaves methanol extract were evaluated for antitumor activity against Ehrlich ascites carcinoma (EAC)-in Swiss albino mice. This examination deals with the impact of extract on the development of transplantable murine tumor, life length of EAC-which beared a hosts, biochemical parameters, and hematological profile, for example, superoxide dismutase (SOD), glutathione content (GSH), lipid peroxidation (LPO), and catalase (CAT) activities. Extract instigated huge ($P<0.01$) decline in packed cell volume, tumor volume, and viable cell count; and it delayed the life expectancy of EAC-tumor bearing mice. The outcomes show that MECB displayed significant antitumor and antioxidant action in EAC-in mice^[65].

Immunomodulatory activity

Caesalpinia bonducella is a strong immunostimulant, exciting both nonspecific and specific immune mechanisms. The administration of ethanolic seed concentrate of *Caesalpinia bonducella* fundamentally enhanced the all-out WBCs count,

RBCs count, hemoglobin, and platelets number and furthermore reestablished the myelosuppressive impacts induced by cyclophosphamide^[66]. Evaluation of immunomodulatory potential of *C. bonducella* seed ethanolic extract instigated noticeable upsurge in percent neutrophil adhesion to nylon fibers. *C. bonducella* contain immunomodulatory activity which can be utilised to prevent autoimmune ailments^[67]. Evaluation of the aqueous concentrate of *C. bonducella* seeds on cell humoral and intervened components of the immune system in rats shows a change in delayed-type hypersensitivity and an upsurge in hemagglutinating antibody titer endorsing that the concentrate could be a promising immunostimulatory agent^[68]. The evaluation of immunomodulatory potential by oral organization of ethanolic seed concentrate of *Caesalpinia bonducella* (200-500 mg/kg) evoked a significant increment in percent neutrophil adhesion to nylon filaments. It likewise demonstrated the dependent on dose it increase in antibody titre values^[69].

Diuretic activity

C. bonduc methanolic and aqueous concentrates confirmed a dependent on dose increase in discharge of urine. As for the aqueous extract, the urinary excretion increase extremely at dose of 300 mg/kg compared with the methanol extract. The study delivers a quantitative basis to clarify the traditional use of *C. bonduc* as a diuretic agent in Moroccan people^[70].

Anti-diabetic activity

In diabetic rats, both the polar extract (aqueous and ethyl acetic acid) along with glibenclamide, demonstrated good hypoglycaemic impact, in addition, reversing changes induced in diabetes mainly in liver glycogen and lipid levels. The non-polar extract concentrate were concerned, the ether extract proved a minor antidiabetic action, while the petroleum ether extracts ineffective to indicate any^[71]. Watery, ethanol and chloroform extracts had demonstrated good protection and brought down the blood glucose levels to ordinary in glucose tolerance test. In alloxan prompted diabetic rats the greatest decline in blood glucose was seen after 3h at a dose level of 250 mg/kg weight of the body. In the extensive treatment of alloxan prompted diabetic rats, the level of assurance was determined by assessing blood glucose, urea, triglycerides, and cholesterol levels on 0,3,5,7 and 10th day^[72].

The oral administration of the ethanolic and petroleum ether *Caesalpinia bonducella* seed extract at a dose of (300 mg/kg) brought enormous antihyperglycemic activity as well as it took down the BUN levels significantly^[73]. The hydroalcoholic concentrate of *Caesalpinia bonducella* seed lessened blood glucose levels fundamentally in normal mice, hyperglycemia mice and alloxan- initiated diabetic mice^[74]. Hydroethanolic concentrate of *Caesalpinia bonducella* seed demonstrated that it diminished fasting blood glucose levels^[75]. *Caesalpinia bonducella* leaves extracts effectively reduced plasma GOT (Glutamic oxaloacetic transaminase), GPT (glutamic pyruvic transaminase), LDH (Locate dehydronase) activities in diabetic rats, suggesting that the hydroalcoholic extracts of *Caesalpinia bonducella* leaves may prevent hepatic injury associated with diabetes^[76].

Antispermatogetic activity

Oral organization of *Caesalpinia bonduc* (L.) Roxb. (Caesalpinaceae) seeds aqueous extract fetched about 40% decrease in sperm count. The treatment results in slow weakening of normal thickness of sperm from 27.63

(Million/Ml) in charge to 25.11, 20.63 and 16.63 at the dose of 50, 100 and 150 mg/kg correspondingly. The conclusions verified that the seed extricate significantly weakened sperm density and rat's show (9.06%), (25.29%) and (39.79%) normal enhance in Antispermatogenic activity by means of increasing dose of concentrations^[77].

Sperm effect

Alcoholic extract of *C. bonducella* seed demonstrate morphological changes in the sperm of albino experimental rats. Examination of graded doses of alcoholic confirmed changes in morphology of the sperm of albino rats. The consequence can be a direct result of general unsettling effects in a change in the cauda epididymal milieu and in proteins most probable because of androgen inadequacy secondary to *C. bonducella* treatment^[78].

Anti-estrogenic activity

Kanchan R, *et al.*, results proposed that *Caesalpinia bonducella* seed alcoholic extract shows antiestrogenic property, conceivably acting through estrogen secretion inhibition^[79]. In rural India abortifacient activity of the seeds of *C. bonducella* is utilised traditionally in the fertility regulations of in females. The leaves are employed as an emmenagogue and to smooth out the delivery in pregnant ladies. The mixture of seed powder of *C. bonducella* with sesame oil for carrying out abortion. It suggests that the plant has abortifacient activity^[80].

Anti-fertility activity

The administration of *Caesalpinia bonduc* exhibited substantial anti-estrogenic activity, anti-implantation activity, abortion, antiovolatery activity and anti-estrogenic activity. Root bark of *Caesalpinia bonduc* Linn. Roxb. Can be utilized for cause sterility i.e. it can be utilized as anti-fertility agent^[80].

Conclusion

From the numerous scientific research founded on *Caesalpinia bonduc*, the plant has enormous biological potential. Numerous chemicals existing in the plant demonstrate an extensive pharmacological and medicinal property. Additional evaluation and research desires to be done to isolate and identify different chemicals present in the plant which will be utilized for a countless application for human welfare in forthcoming.

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