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The contents and pharmacological importance of *Corchorus capsularis*- A review

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Abstract: Seeds of *Corchorus capsularis* contained cardiac glycosides, corchorin, corchortoxin helveticoside, corchoroside A and B, biosides, olitoriside, erysimoside, strophantidol glycosides, oliogosaccaride and olitoriside; while leaves contained flavonoids, triterpenes, saponins, glucoside, capsularin steroids and many other secondary metabolites. The pharmacological studied revealed that te plant possessed cardiac, antioxidant, antiinflammmatory, analgesic, antipyretic, antimicrobial, insecticidal and many other pharmacological effects. This review was designed to highlight the chemical constituents and pharmacological effects of *Corchorus capsularis*

Keywords: *pharmacology, constituents, pharmacognosy, Corchorus capsularis*

I. INTRODUCTION

During the last few decades there has been an increasing interest in the study of medicinal plants and their traditional use in different parts of the world[(1)]. Plants generally produce many secondary metabolites which were constituted an important source of many pharmaceutical drugs[(2-21)]. Seeds of *Corchorus capsularis* contained cardiac glycosides, corchorin, corchortoxin helveticoside, corchoroside A and B, biosides, olitoriside, erysimoside, strophantidol glycosides, oliogosaccaride and olitoriside; while leaves contained flavonoids, triterpenes, saponins, glucoside, capsularin steroids and many other secondary metabolites. The pharmacological studied revealed that te plant possessed cardiac, antioxidant, antiinflammmatory, analgesic, antipyretic, antimicrobial, insecticidal and many other pharmacological effects. This review will highlight the chemical constituents and pharmacological effects of *Corchorus capsularis*

II. PLANT PROFILE

Synonyms: *Corchorus cordifolius* Salisb., *Corchorus marua* Buch.-Ham[(22)].
Taxonomic classification:

Kingdom: Plantae; **Sub Kingdom**: Viridaeplantae; **Infra Kingdom**: Streptophyta; **Phylum**: Magnoliophyta; **Division**: Tracheophyta; **Subdivision**: Sparmatophytina; **Class**: Magnoliopsida; **Order**: Malvales; **Family**: Malvaceae (Tiliaceae)**; Genus**: Corchorus; **Species**: *Corchorus capsularis* L[(23)].

Common names:
Arabic: Joot Abiadh, Melukhiyah**; Bangladesh**: Koshta; **Chinese**: huang ma, **English:** Jute**,** White Jute; **French:** chanvre de Calcutta; **German**: Rundkapseljute; **Hindi:** Patta Shaak; **Italian:** juta**; Kenya:** Mrenda, Murere; **Korean**: hwangma; **Nigeria:** Rama**; North Africa:** Melukhiyah**; North Sudan:** Khudra; **Phillipines**: Saluyot; **Portuguese**: juta; **Seria Leone:** Krain; **Spanish**: yute blanco; **Swedish**: jute and **Tamil:** Pirattai-keerai[(24-25)].

Distribution:
The origin of white jute (*Corchours capsularis*) was said to be Indo-Burma and South China. However, it was grown in, Iran, Iraq, Bangladesh, Bhutan, India, Nepal, Pakistan, Sri Lanka, Myanmar, Thailand, Taiwan, Vietnam, Indonesia, Malaysia, Philippines, in Africa (Egypt and Sudan), in Brazil and it was also cultivated elsewhere[(25-26)].

Description:
Annual herb up to 3.5 m tall, stem straight, smooth, cylindrical, very tall, upper portion branched. Leaves light green, thin, oval, narrow pointed, toothed. Flowers solitary or on 3 short, thick stalks, small, yellow. Capsules short, globose, flattened at the top, wrinkled, ribbed, 5-valved. Seeds few in each valve, without transverse partitions[(27)].

Traditional uses:

Jute was known as the golden fiber. It was the most important cash crop. Jute fiber was produced mainly from two important species: White Jute (*Corchours capsularis*), and Tossa Jute (*Corchorus olitorius*). Jute was used as packaging materials like gunny bag, twill, carpet backing, wool pack, twine, hessian, mats, canvas, rug, handicrafts, wall cover, and furnishing fabrics of different types and natures. Now a day, it has been used as a popular raw material for packaging. Highly absorptive fiber made from jute was used for surgical dressings. Before being used as a commercial commodity it was used in different parts of the world to make household and farm implements such as ropes, handmade clothes, wall hangings, etc. Paper also made from Jute[26].
Leaves were also used medicinally as demulcent, bitter tonic, stomachic, laxative, carminative anthelmintic, astringent and intestinal antiseptic. Infusion of dried leaf was bitter and commonly used as a stomachic tonic, also used in fever, bilious trouble dysentery, liver disorders, intestinal colic, gastric catarrh, skin diseases, atonic dyspepsia, mild jaundice and other disorders of digestive system. For the treatment of dysentery, dried leaves are eaten with rice. It was also used as a paste over swellings and abscesses[27].
In India, leaves were used in stomachic, as carminative, diuretic and for the treatment of dysentery (dried leaves), while, seeds were used as purgative. Ayurvedics used the leaves for ascites, pain, piles, and tumors. The leaves also were used for cystitis, dysuria, fever, and gonorrhea. The cold infusion was said to restore the appetite and strength[28-30].
The aqueous/alcoholic extracts (containing polysaccharides and oliogosaccaride), were used in preparations of skin cosmetics or hair preparations for their moisturizing effect[30].
Part used: Seeds and leaves[26-30].

Chemical constituents:
Seeds contained cardiac glycosides, corchorin, corchortoxin helveticoside, corchoroside A and B, biosides, olitoriside, erysimoside, strophantidol glycosides, oliogosaccaride and olitoriside. Seed also contained 2.25% raffinose, 11.3-14.8% oil (16.9% palmitic acid, 3.7% stearic acid, 62.5% linoleic acid, 0.9% linolenic acids,1.8% behenic acid, 1.1% lignoceiic acid, 9.1% oleic acid) and large portions of B, Mn, Mo, and Zn. Caffeine and catechine were also isolated from *Corchorus capsularis* leaves extract[26, 30-35].
Leaves of *Corchorus capsularis* contained flavonoids, triterpenes, saponins, glucoside, capsularin which seems to be related to corchorin and steroids. A new triterpine glycosides (capsin) and capsugenin 30-O-glucopyranoside were isolated from the leaves of *Corchorus capsularis* [27, 36-39]. β-sitosterol, scopoletin and fusidic acid were also isolated from the leaves [40].

The polysaccharides and lignin are the major constituents in bark, stem and fiber of *Corchorus capsularis*. Glucose, fructose, sucrose, six low molecular weight sugar alcohols and two inositols were identified and quantified in bark. Bark and stem of *Corchorus* capsularis contained various free glycosidic and ester- linked phenolic acid. The ferulic and p-coumarin acids were the major components of phenolic acid in fresh bark[41].

The crude methanolic extract of *Corchorus capsularis* leaves and its fructions were subjected to total phenolic content determination. Based on the absorbance values of the extract solution, reacted with Folin-Ciocalteu reagent and compared with the standard solutions of salicylic acid equivalents, cholorform extract extract contained the highest amount of polyphenols followed by butanol extract and ethyl acetate extract[42].
P-coumaric acid, ferulic, caffeic, vanillic, p-hydroxybenzoic, protocatechuic, vanillic acids, in addition to β-sitosterol were isolated from 80% aqueous ethanol extract of *Corchorus capsularis* [43-45].
Cardiac glycosides (corchoroside-A and cannogenol), steroids (β-sitosterol and stigmasterol 3-O-β-D-glucoside), flavonoids (quercetin), terpenoids (betulinic and oleanolic acids) were isolated from root extract of *Corchorus capsularis*[46]. In addition corosin 0.2% was also isolated from *Corchorus capsularis* roots[47].
Nutritional chemical analysis showed that leaves contained protein 3.86%, *β*-Carotene 61.33 mg/kg, iron 70.63 mg/kg and potasium 4043mg/kg[48]. However, Tabassum mentioned that each 100g of the leaves contained 43-58 calories, 4.5-5.6g protein, 0.3g fat, 7.6-12.4g carbohydrate, 80.4-84.1g H2O, 1.7-2.0g fiber, 2.4g ash, 266-366mg Ca, 97-122mg P, 7.2-7.7mg Fe, 12mg Na, 444mg K, 6,410-7,850µg beta-carotene equivalent, 0.13-0.15mg thiamine, 0.26- 0.53mg riboflavin, 1.1-1.2mg niacin, and 53-80mg ascorbic acid. Leaves contain oxydase and chlorogenic acid. The folic acid content was substantially higher than other folacin-rich vegetables[26].

Jute fiber was collected from the bast or outer region of the stem after retting of the whole plant[49].
The lipid and lignin composition of jute fibers has been characterized. The most predominant lipophilic compounds were high molecular weight ester waxes (24% of total extract), followed by free fatty acids (17%), free fatty alcohols (17%) and α-hydroxy fatty acids (14%). Additionally, significant amounts of alkanes (6%), ω- hydroxyfatty acids (6%), sterols (6%), steroid and triterpenoids ketones (3%) and steryl glycosides (1%)

were also identified. The main inter-unit linkage present in, was the β-O-4′ aryl-ether bond (72%) followed by β-β′ resinol-type substructures and with lower amounts of β-5′ phenylcoumaran and β-1′ spirodienone substructures[50].

Pharmacological effects:

Cardiac effect:

Corchortoxin (strophanthidin) was a cardiac aglycone isolated from *Corchorus capsularis* seeds, showed a cardio-tonic activity. These activities were similar to digitalis genus. However, jute seeds extract showed better activities than corchortoxin. Corchoroside A and B, which also isolated from other plants also showed digitalis like action[51-55].

Anticancer effect:

Two antitumor against tumor promoter-induced Epstein-Barr virus activation were isolated from the leaves of jute (*Corchorus capsularis*). The antitumor-promoting activity was examined by an immuno blotting analysis. Their active components were identified as phytol (3,7,11,15-tetramethyl-2-hexadecen-1-ol) and mono-galactosyldiacylglycerol (1,2-di-*O*-α-linolenoyl-3-*O*-β-D-galactopyranosyl-*sn*-glycerol)**.** The content of the latter was found to vary among cultivars. The detectable amount of each active component increased by treatment of the leaves with hot water[56].

Brine shrimp lethality bioassay was carried out to determine the cytotoxicity of the crude methanolic extract of *Corchorus capsularis* (leaves) and its fructions. Butanol extract was the most potent extract (71.14% inhibition at a concentration of 1.25 mg/ml), followed by ethyl acetale (28.57% inhibition at a concentration of 1.25 mg/ml) and methanol extract (14.28% inhibition at a concentration of 1.25 mg/ml)[42].

Antioxidant effect:

The free radical scavenging properties of some plants found in Malaysia such as, *Corchorus capsularis* was studied. The air-dried leaves of the plant (20 g) were soaked in distilled water (1:20; w/v) for 72 h at room temperature. The collected supernatants were tested for the free radical scavenging activity against the DPPH and superoxide anion radical scavenging assays. The extract showed remarkable antioxidant activity in both assays with the percentage of inhibition nearly 90%[37].

The crude methanolic extract of *Corchorus capsularis* (leaves) and its fructions (5-25 µg/µl), were tested for the free radical scavenging activity against the DPPH and superoxide anion radical scavenging assays. Extracts were found to show remarkable antioxidant activity in both assays with the percentage of inhibition. Hexan extract caused 65.44-97.43% inhibition and appeared the most potent antioxidant extract, followed by butanol, methanol and ethyl acetate extracts[42].

Anti-inflammatory, analgesic and antipyretic effects:

The antinociceptive and anti-inflammatory properties of *Corchorus capsularis* leaves chloroform extract were investigated in experimental animal models. The antinociceptive activity was measured using the writhing, hot plate and formalin tests, while the anti-inflammatory activity was measured using the carrageenan-induced paw edema test. The extract was used in the doses of 20, 100 and 200 mg/kg. It was administered subcutaneously, 30 min prior to subjection to the respective assays. The extract was found to exhibit significant ($p<0.05$) antinociceptive and anti-inflammatory activities[57].

The antinociceptive, anti-inflammatory and antipyretic properties of an aqueous extract of *Corchorus capsularis* leaves were studied in experimental animals. The antinociceptive activity was measured using the abdominal constriction, hot plate and formalin tests, while, the anti-inflammatory and antipyretic activities were measured using the carrageenan-induced paw edema and brewer's yeast-induced pyrexia tests, respectively. The extract was used as 11.57, 57.85, and 115.7 mg/kg, it was administered subcutaneously, 30 min prior to subjection to the mentioned assays. The extract was found to exhibit significant antinociceptive, anti-inflammatory and anti-pyretic activities in a dosage-independent manner[58].

Antimicrobial effects:

Disc diffusion method was used to determine the antibacterial and antifungal activity of the crude methanolic extract of *Corchorus capsularis* (leaves) and its fructions against Gram positive bacteria (*Bacillus subtilis, Staphylococcus aureus, Beta hemolytic streptococcus, Bacillus cereus and Streptococcus pyrpgen*), Gram negative bacteria (*Shigella boydii, Salmonella typhi E.coli, Klebsiella* and *Vibrio mimicus*), yeast and fungi (*Candida albicans, Saccharomyces cerevisiae* and *Bacillus megaterium*). *Corchorus capsularis* extracts possessed antimicrobial antifrungal and anti-yeast activity. N-hexane fraction of methanolic extract of leaves of *Corchorus capsularis* showed the highest acivities against gram positive, gram negative bacteria and fungi with a zone of inhibition 0.9-1.5mm, followed by hexane extract[42].

Insecticidal effect:

The mosquitocidal activities of *Corchorus capsularis* against a common malarial vector, *Anopheles stephensi* and a dengue vector *Aedes aegypti* was studied . The larvicidal activity exerted by ethyl acetate was more prominent than acetone and methanol extracts in all concentrations tested against *Ae. aegypti* larvae. Evaluation of the lethal concentration values (LC_{50} and LC_{90}) of acetone, ethyl acetate and methanol extract of the plant against *An. stephensi* and *Ae.aegypti* revealed that LC_{50} of 197.34ppm and LC_{90} of 358.59ppm was recorded for acetone extract against the *An. stephensi*; furthermore, the larvae of *Ae. aegypti* showed the LC_{50} and LC_{90} values of 222.45 and 383.06ppm respectively, with the treatment with the acetone extract of *Corchorus capsularis*. Minimum LC_{50} values were observed among the experimental larval groups treated with methanol extract of *Corchorus capsularis* were 176.19ppm and 182.06ppm against *An. stephensi* and *Ae. Aegypti* respectively. With regard to the ovicidal activity of acetone, ethyl acetate and methanol extract, it was apparent that 300 -450 ppm concentrations resulted with no hatchability on *An. stephensi* and 375-450pp concentrations in *Ae. aegypti*. The authors refered to the possible utilization of *Corchorus capsularis* to control mosquito menace to a greater extent[(59)].

The efficacy of emulsified petroleum ether extract of *Corchorus capsularis* seed was studied against three stored product pests (*Callosobruchus chinensis*, *Sitophilus oryzae* L and *Tribolium castaneum* Herbst) in adult phase. The residual film technique method was conducted to determine the LC_{50} value of the mentioned plant extract against three stored product pests. LD_{50} (µg /cm) of *Corchorus capsularis* against *C. chinensis* was 74.26 (50.26 - 109.74) after 24 hrs and 6.67 (0.49 - 90.07) after 48hrs. LD_{50} against *S. oryzae* was 84.61 (61.98-115.50) after 24 hrs and 32.87 (16.03-67.39) after 48hrs. While, LD_{50} against *T. castaneum* was 547.08 (477.38 - 626.97) after 24 hrs and 452.51 (380.30 - 538.42) after 48hrs[(60)].

However, On the other hand, in studying of the role of jute leaf (*Chorchorus capsularis*) phytochemicals on feeding, growth and reproduction of *Diacrisia casignetum* Kollar (Lepidoptera: Arctiidae), it appeared that the larval and post larval developmental duration was shorter on mature jute leaf fed insects whereas adult longevity was higher in it ($P < 0.05$) relative to young and senescent leaf fed insects. Fecundity of *D. casignetum* was also highest on mature leaves followed by young and senescent leaves. The growth and development of *D. casignetum* were related to the nutrient content relative to the secondary metabolites of these three types of jute leaves. Higher levels of nutritional factors (total carbohydrates, proteins, lipids, nitrogen and amino acids including water content) and lower levels of anti-nutritional factors (secondary metabolites) in mature jute leaves have influenced lower developmental time along with higher growth rate, fecundity and accumulated survivability of *D. casignetum* than the young and senescent leaves[(61)].

Toxicity:

The plant was considered toxic plant because it contained cardioactive components. However, the lethal dose of Corchoroside A, to cats was 0.053-0.0768 mg/kg and Corchoroside B was 0.059-0.1413 mg/kg[(26)].

III. CONCLUSION

The review discussed the cemical constituents, pharmacological effects and therapeutic importance of *Corchorus capsularis.*

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