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Revision: Chemical and biological activities of *Corchorus olitorious* L.

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ABSTRACT

The present study was conducted on the basis of previous chemical and biological; national and international research works on *Corchorus olitorious* Linn. For this, published articles, dissertations, magazines, and book reports were collected, from the past up to 2012. Aim of the work was targeted to exploit the medicinal information among both the users and non-users, benefited by this species world-wide in. Protein, lipid, calcium, iron, carotene, vitamins, folic acid and some enzymes have been reported from the leaves, still used as vegetables. Essential phytoconstituents like flavonoids, saponins, tannins, steroids, glycosides, sugars and triterpenes isolated from leaf, bark, root and seeds of the *C. olitorious* have been reported for their cardiac, anti-malarial and hepato-protective activities.

Keywords: Bangladesh, biological, chemical, *Corchorus olitorious* L.

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INTRODUCTION

The word jute is probably coined from the word *jhuta* or *jota*, an Orrisan word¹. However, the use of *jutta potta* cloth was mentioned both in the Bible and Monushanghita-Mahabharat¹. Jute is known as golden fibre of Bangladesh due to it is the main cash crop for the country, since Bangladesh supplies more than 95 percent of the world's requirement of this important fibre¹.

Jute grows under wide variation of climatic conditions and stress of tropic and subtropics. It is grown in India, Myanmar, Nepal, China, Taiwan, Thailand, Vietnam, Cambodia, Brazil and some other countries².

While perhaps better known as a fiber crop, jute is also a medicinal "vegetable", eaten from Tanganyika to Egypt. They are used in soups under the Arabic name "Molukhyia". In Bangladesh and India the leaves and tender shoots are eaten. The dried material is there known as "nalita". Injections of olitoriside markedly improve cardiac insufficiencies and have no cumulative attributes; hence, it can serve as a substitute for strophanthin³.

Reported to be demulcent, deobstruent, diuretic, lactagogue, purgative, and tonic, tussa jute is a folk remedy for aches and pains, dysentery, enteritis, fever, dysentery, pectoral pains, and tumors^{4,5}.

Ayurvedic use the leaves for ascites, pain, piles, and tumors. Elsewhere the leaves are used for cystitis, dysuria, fever, and gonorrhoea. The cold infusion is said to restore the appetite and strength⁶.

The present study was conducted on the basis of previous chemical and biological; national and international research works. For this, published articles, dissertations, magazines, and book reports were collected, from the past up to 2012. Aim of the work was targeted to exploit the medicinal use of *Corchorus olitorious* (Local name: nalta jute, tussa jute) among world-wide.

Description of the tussa jute (*C. olitorious*)

Corchorus (Family: Tiliaceae) is a genus of annual herbs. Nearly 40 species are known to occur in nature and distributed in the tropics of both the hemispheres⁶. *C. olitorious* is annual, much-branched herb 90-120 cm tall; stems glabrous. Leaves 6-10 cm long, 3.5-5 cm broad, elliptic-lanceolate, apically acute or acuminate, glabrous, serrate, the lower serratures on each side prolonged into a filiform appendage over 6 mm long, rounded at the base, 3-5 nerved; petioles 2-2.5 cm long, slightly pubescent, especially towards the apex; stipules subulate, 6-10 mm long. Flowers pale yellow; bracts lanceolate; peduncle shorter than the petiole; pedicels 1-3, very short. Sepals ca 3 mm long, oblong, apiculate. Petals 5 mm long, oblong spatulate. Style short;

stigma microscopically papillose. Capsules 3-6.5 cm long, linear, cylindric erect, beaked, glabrous, 10-ribbed, 5-valved; valves with transverse partitions between the seeds. Seeds trigonous, black⁷.

Distribution

Rather pantropical in distribution, perhaps more often a weed than a cultivar. Considered a serious weed in Australia, Egypt, Mozambique, the Philippines, Senegal, and Thailand, a principal weed in the Sudan, and a common weed in Afghanistan, India, Kenya, Nepal, Turkey, and Zambia⁸. Systematic attempts have been made to grow jute in West Africa, Sudan, Egypt, Turkey, Iran, Thailand, Java, Paraguay, Brazil, Argentina, and Mexico.



Figure 1: *Corchorus olitorius* L. (Author)

Ecology

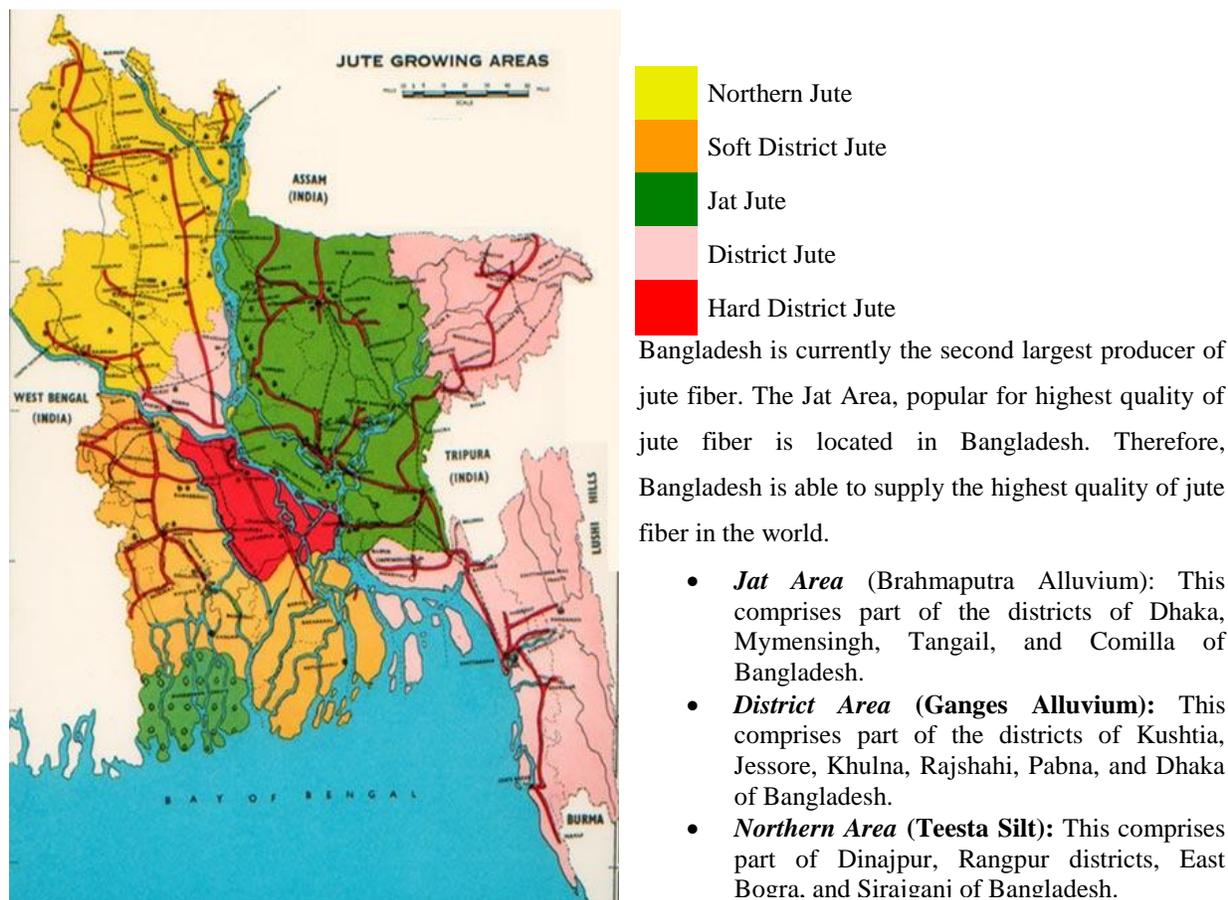
Ranging from Warm Temperate Thorn through Tropical Desert to Wet Forest Life Zones, tussa jute is reported to tolerate annual precipitation of 4.0 to 42.9 dm (mean of 15 cases = 18), annual temperature of 16.8 to 27.5°C (mean of 15 cases = 23.8), and pH of 4.5 to 8.2 (mean of 13 cases = 6.5)⁹.

Cultivation

In India, seeds are sown in (Feb.-) Mar-May (June) in carefully prepared soil, plowed and cross plowed 5 or 6 times, clay soils requiring more plowing. Cow dung and wood ashes are applied as manure. Rotted water hyacinth or its ashes may also be applied. Seeds are broadcast or dribbled behind the plow. When soils are moist, seeds may germinate in 2-3 days. If germination is bad, replowing and resowing is recommended. Starting at 8-25 cm tall, the seedlings are harrowed with a rake 3 to 4 times, and weeded 2 to 3 times. After the final weeding, plants are spaced at 10-15 by 15 cm. Highest yields were obtained (ca 3000 kg/ha) with 80 kg/N compared to 1700 per ha in unfertilized controls³.

MATERIALS AND METHODS

Data from published articles, periodicals, book and e-book were made to congregate for the revision study.



Bangladesh is currently the second largest producer of jute fiber. The Jat Area, popular for highest quality of jute fiber is located in Bangladesh. Therefore, Bangladesh is able to supply the highest quality of jute fiber in the world.

- **Jat Area** (Brahmaputra Alluvium): This comprises part of the districts of Dhaka, Mymensingh, Tangail, and Comilla of Bangladesh.
- **District Area** (Ganges Alluvium): This comprises part of the districts of Kushtia, Jessore, Khulna, Rajshahi, Pabna, and Dhaka of Bangladesh.
- **Northern Area** (Teesta Silt): This comprises part of Dinajpur, Rangpur districts, East Boera. and Siraigani of Bangladesh.

Image 2: Jute growing areas in Bangladesh (Author)

RESULTS AND DISCUSSION

Tussa jute leaves as vegetables

Leaves of *C. olitorious* is a popular vegetables in Bangladesh and India where it is called “pat shakh”. In Malays it is known as “kancing baju”¹⁰. The Yoruba of Nigeria call it “ewedu”. The Hausa people of Nigeria and their Fulbe neighbours call it “rama”. In Northern Sudan it’s called “khudra” meaning green in Sudanese Arabic. The Songhay of Mali calls it “fakohoy” whereas Tunisians call it “mulukhiyah”. In Egypt call it “mulukhiyya”, Cypriots call it “molocho”. The Philippines call it “saluyot”. Jute leaves are also consumed among the Luyhia people of Western Kenya, where it is commonly known as “mrenda or murere”. Japan has been importing dry jute leaf from Africa and they are using it as the substitute of coffee and tea. In Europe, jute leaves are being used as soup² (table 1).

Ingredients (leaf)

Phytochemical findings

Extensive phytochemical study revealed that several glycosidic compounds, referred to as corchorin, were isolated from different *Corchorus* species¹⁴⁻¹⁸ but no definite conclusions could

be drawn regarding the structures of these compounds. Similar was the fate of capsularin¹⁹, chorchoritin²⁰ and corchsularin²¹. In the same manner, a number of aglycones namely corchssugenin²¹, corchortoxin²² and corchorgenin^{23,24} were isolated. A significant advancement was made when these aglycones were chemically identified as strophanthidin 1²⁵, the familiar aglycone of the cardiac glycoside strophanthin. This was followed by identification of 2-deoxy riboside and 2-deoxy-3-0-methyl riboside of strophanthidin^{26,27}, though the position of the sugar residue was not defined. Two digitalis glycosides, corchoroside A 2 and corchoroside B 15²⁸ were isolated respectively from *C. olitorius*. A monoglucoside²⁹⁻³² of corchoroside a from *C. olitorius*, a diglucoside and a triglucoside³³ of corchoroside A were also identified. Monoglucoside of of corchoroside A was named as olitoriside 3³⁴.

Table 1. Nutritional status of *C. capsularis* leaf (per 100 g)^{12,13}

Ingredients with unit	Amount
Calories (kcal)	73
Protein (g)	3.6
Lipid (mg)	600
Calcium (mg)	298
Iron (mg)	11
Carotene (mg)	6400
Vitamin C (mg)	64

Loshkarev³⁵ reconfirmed the presence of corchoroside A in the seeds of *C. olitorius*. An extract of the seeds of *C. olitorius* after enzymic hydrolysis, gave a fair yield of corchoroside A³⁶. Seeds of *C. olitorius*, besides erysimoside, gave a cardinolide glycoside, trioside of strophanthidin, having a structure identical with the polar glycoside of *C. capsularis*³⁷. Seeds³⁸⁻⁴¹ of *C. olitorius* gave glycosides, coroloside and deglycocoroloside, cardiac glucosides, canarigenin 3-0-B-D-glucopyranosyl-(1-4)-0-B-D-allomethylpyranose/altromethylpyranose **13**, cannogenol 3-0-B-D-glucopyranosyl-(1-4)-0-B-D-boivinopyranoside **6**, periplogenin 3-0-B-D-glucopyranosyl-(1-4)-0-B-D-digitoxopyranoside **7** and digitoxigenin 3-0-B-D-glucopyranosyl-(1-6)-0-B-D-glucopyranosyl-(1-4)-0-B-D-digitoxopyranoside **8** and some new cardiotoxic oligoglycosides corchorosides A-E **16-20**. *C. olitorius* seeds from Japan⁴² contained cardiac glycosides (approx 1.0% level wet weight). The dark greyish green seeds contained more cardiac glycosides as compared to the dark grayish yellow or yellowish green seeds. The methanolic extract of seeds gave digitoxigenin glycosides, coroloside and glucoevatromonoside, as well as strophanthidin glycosides, erysimoside, olitoriside, corchoroside A and helveticoside, as the main cardiac glycosides⁴³.

Helveticoside was extracted from the seeds (petroleum ether extract)⁴⁴. Then strophanthidin,

strophanthidol, corchoroside A, and olitorin were also reported from seeds of *C. olitorius*⁴⁵. An acidic polysaccharide, isolated from water soluble mucilage extracted from dried leaves of *C. olitorius*, was rich in uronic acid (65%), and consisted of rhamnose, glucose, galacturonic acid and glucuronic acid in a molar ratio of 1.0: 0.2: 0.2: 0.9: 1.7 in addition to the acetyl group (3.7%)⁴⁶.

A triterpenoid corosin, isolated from roots of *C. olitorius* on refluxing with HCl, gave corosic acid³⁴, however, structures of both these compounds were not established⁴⁷. Further extension of the work established structure of corosin **21**, which on treatment with sulphuric acid and acetic acid gave the anhydrolactone by dehydration of one molecule of water involving OH group at C-19 and carboxylic acid group at C-17 position⁴⁸. Ursolic acid **25**, corosolic acid **26** and oxo-corosin were isolated from fresh, undried roots of *C. olitorius*⁴⁹. Isolation of oleanolic acid **25a** also has been reported from the leaves of *C. olitorius* of Egyptian origin⁵⁰.

Leaves⁵¹ of *C. olitorius* contain ionone glucosides, corchoionosides A **40**, B **41** and C **42**, an ionone glucoside (6*S*, 9*R*)- roseoside **43** and a monoterpene glucoside betulabuside A **44**. Isolation and characterization of astragalin **51** and isoquercitrin **52** from *C. olitorius* leaves⁵¹ have been reported. Leaves^{50,52} of *C. olitorius* (Egyptian origin) also contain four flavonoidal glycosides, astragalin (kaempferol-3-0-B-D-glucopyranoside), tolifolin (kaempferol-3-0-B-D-galactopyranoside), isoquercitrin (quercetin-3-0-B-D-glucopyranoside) and jugulanin (kaempferol-3-0-B-L-arabinopyranoside), besides quercetin-3-galactoside **53**, quercetin-3-(6 malonyl glucoside) **54** and quercetin-3-(6 malonyl galactoside) **55** (tentative).

Two coumarin glucosides, cichoriine **58** and scopolin **59** were isolated from the leaves of *C. olitorius*⁵¹, the first report of the isolation of coumarins from this genus. Isolation of 5-caffeoylquinic acid (chlorogenic acid)^{51,52} **60** and 3,5-dicaffeoylquinic acid⁵² **61** from the leaves of *C. olitorius* have also been reported. From chloroform extract of defatted seeds of *C. olitorius*, a new coumarin was isolated as 4,7-dihydroxycoumarin **62**⁵³. Isolation of B-sitosterol **63** from *C. olitorius* roots⁴⁷ and B-sitosterol 3-0-B-D-glucopyranoside from the leaves of *C. olitorius* of Egyptian origin have been reported⁵⁰. Fatty acid composition of seed oil of *C. olitorius* was reported earlier⁵⁴. Leaves⁵⁵ of *C. olitorius* gave four higher fatty acids with a trienone system, corchorifatty acids A **65**, B **66**, C **67**, D **68**, an undecanoic acid, corchorifatty acid E **69** and a trihydroxy fatty acid, corchorifatty acid F **70**. Presence of glyceryl monopalmitate has been reported in leaves of Egyptian origin⁵⁰.

Pharmacological findings

All cardenolides, oligoglycosides (corchorosides A-E) isolated from the seeds of *C. olitorius*

showed potent inhibitory activity against Na, K-ATPase, which was equivalent to that of digitoxin ouabain⁴². Clinical effects of Soviet manufactured strophanthoids studied on 2000 human patients with cardiac decompensation. Most active drugs were found to be olitoriside and corchoroside from *C. olitorius*⁵⁶. Seed extract of *C. olitorius* was tested on seven isolated intact Langendroff perfused rabbit hearts. Left ventricular pressure, coronary flow and heart rate were recorded. The seed extract induced an increase in both left ventricular pressure and coronary flow⁵⁷.

Cochoionoside A **40**, B **41** and (6*S*, 9*R*)-roseoside **43** from *C. olitorius* inhibit the histamine release from rat peritoneal exudates cell induced by antigen-antibody reaction⁵¹. An increase in body weight (including weight of liver) was noticed in test animals after feeding with a protein-enriched diet from *C. olitorius* seeds. AST, ALT and total lipid of liver increased significantly whereas AST and ALT of serum decreased⁵⁸. A cholesterol free diet containing dried green leaves powder of *C. olitorius* lowered hepatic cholesterol concentration and increased neutral sterols excretion in rats⁵⁹. Methanol extract of *C. olitorius* on liver and kidney functions and hematological parameters in mice were studied. Significant increase in clotting time was seen in moderate and high doses. The extract cause significant increase in WBC count only at a high dose level of treatment. SGOT, SGPT, NPN and plasma cholesterol levels increased significantly at medium and high dose levels. Serum alkaline phosphatase and total bilirubin levels were also increased by both moderate and high dose levels of treatment. Low doses of the extract did not exhibit any significant change of creatinine and serum protein levels, but the high dose level significantly increased creatinine level⁶⁰.

Aqueous extract of *C. olitorius* showed a strong growth inhibition (>96%) of the malaria parasite *Plasmodium falciparum*⁶¹. Methanolic extract of *C. olitorius* showed a significant anticonvulsive activity by altering the levels of catecholamines and brain amino acids in mice⁶². Methanolic extract of *C. olitorius* seeds⁶³ caused a remarkable delay in sexual maturation in mice as evidenced by the age at vaginal opening and appearance of first oestrus. The probable cause of delayed maturation may be due to the suppressed ovarian steroidogenesis. Methanolic extract of *C. olitorius* seeds⁶⁴ arrested normal oestrus cycle of adult female mice and significantly decreased weight of ovaries and uterus.

CONCLUSION

The results of the review provide us with the substantiation of chemical and biological importance of tussa jute to the different communities world-wide. Mainly the cardiac glycosides

are the new research face to the phytochemistry and pharmacology. Moreover, *Corchorus olitorius* can be taken as alternative sources for other constituents applicable to the nutrition, medicine and cosmetics.

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