

Biochemistry, Medicinal and Food values of Jute (*Corchorus capsularis* L. and *C. olitorius* L.) leaf: A Review

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Abstract: Jute (*Corchorus* spp.) leaf has long been used as a remedy in many cultures. Jute leaf products, which include the leaf juice, fried leaf, and some time whole green leaf, are used, among other reasons, as laxatives, in creams for skin care, and as a treatment for a wide range of diseases, respectively. The heterogeneous nature of jute leaf products may contribute to the diverse biological and therapeutic activities that have been observed. Variations in the composition of jute leaf can result in products with different chemical and physical properties, making the comparison of products difficult. The green, leafy vegetable is rich in beta-carotene for good eyesight, iron for healthy red blood cells, calcium for strong bones and teeth, and vitamin C for smooth, clear skin, strong immune cells, and fast wound-healing. Vitamins A, C and E present in jute leaf/Saluyot “spongeup” free radicals, scooping them up before they can commit cellular sabotage. Jute leaf as vegetable contains an abundance of antioxidants that have been associated with protection from chronic diseases such as heart disease, cancer, diabetes, and hypertension as well as other medical conditions. Fresh jute leaf has higher demand. Ayurvedics use the leaves for ascites, pain, piles (laxative), and tumors. Elsewhere the leaves are used for cystitis, dysuria, and fever. The cold infusion is said to restore the appetite and strength. In this article, the biochemistry, uses and pharmacological activity of jute leaf fry, juice and curry compounds are reviewed.

Keywords: Biochemistry, Medicine, Food, Jute (*Corchorus* Spp.) leaf.

1. Introduction

The fibre-yielding plant jute was once known as the golden fibre of Bangladesh, since it was the most important cash crop for the country. Demand for medicinal plants is increasing in both developed and developing countries due to growing recognition of natural products being equally effective, safe, non-narcotic, affordable and having no side effects. There is large scale international trade in the medicinal plants. One such medicinal plant part is jute leaf. Bangladesh and India has been a traditionally rich in various types of medicinal plants. Since ancient times, people have been using herbal medicines to cure diseases. About 20,000 species of plants are being used as medicinal plants world over. The plant products constitute about 25% of the prescribed medicines in world (Anwar, 2011; Alim, 1978; Dempsey, 1975 and Calleja, 2010).

Jute dicotyledenous fibre-yielding plant of the genus *Corchorus*, order Tiliaceae. Jute was once known as the golden fibre of Bangladesh, since it was the most important cash crop for the country. Jute fibre is produced mainly from two commercially important species, namely White Jute (*Corchorus capsularis* L.), and Tossa Jute (*Corchorus olitorius* L.). The centre of origin of white jute is said to be Indo-Burma including South China, and that of tossa Africa. The word jute is probably coined from the word jhuta or jota, an Orrisan word. However, the use of jutta potta cloth was mentioned both in the Bible and Monushanghita-Mahabharat. This indicates the ancient uses of jute materials by the people of these areas (Alim, 1978; Islam, 2009; Islam and Rahman, 2008).

Jute leaves are the leaves of certain jute plants, used as a food source in Asia, the Middle East, and parts of Africa. In addition to adding a distinct flavor to food, jute leaves also have nutritional value, and they act as thickeners in soups, stews, and sauces. Jute leaves may also be called saluyot or ewedu, depending on the region of the world in which one is cooking. It is possible to grow jute for its fresh leaves in some parts of the world, and some specialty stores also stock it in fresh, frozen, or dried form, depending on their location and size (Annon., 2003; Calleja, 2010).

The leaves of these plants are simple, and they may have slightly serrated edges. When harvested young, jute leaves are flavorful and tender; older leaves tend to be more woody and fibrous, making them less ideal for consumption. Jute leaves are consumed in various parts of the world. It is a popular vegetable in West Africa. The Yoruba of Nigeria call it "ewedu". The Hausa people of Nigeria and their Fulbe neighbours call it "rama." They use it to produce soup

("taushe") or boil the leaves and mix it with "Kuli-kuli" or groundnut cake and consume the mixture which they call "kwado" in Hausa. It is eaten with 'ugali', which is also a staple for most communities in Kenya. The leaves are rich in betacarotene, iron, calcium, and Vitamin C. The plant has an antioxidant activity with a significant α -tocopherol equivalent Vitamin E (<http://en.wikipedia.org/wiki/Jute>). Vitamins A, C and E present in jute leaf/Saluyot "spongeup" free radicals, scooping them up before they can commit cellular sabotage. Jute leaf as vegetable contains an abundance of antioxidants that have been associated with protection from chronic diseases such as heart disease, cancer, diabetes, and hypertension as well as other medical conditions. Jute grows under wide variation of climatic conditions and stress of tropic and subtropics. Jute is as old as civilization and has been used in almost as many applications as one can imagine. This paper reviews history, chemical constituents, plant morphology and the most interesting studies on the various biological activities of jute (*Corchorus* spp) (Duke, 1979).

2. History

Tossa and white jute varieties are thought to be native to Bangladesh and India, and are also the world's producer. It is grown for both fiber and culinary purposes. It is used as an herb in Middle Eastern and African countries, where the leaves are used as an ingredient in a mucilaginous potherb called "molokhiya" (ملوخية, of uncertain etymology). It is very popular in some Arab countries such as Egypt, Jordan, and Syria as a soup-based dish, sometimes with meat over rice or lentils. The Book of Job, in the King James translation of the Hebrew Bible mentions this vegetable potherb as "Jew's mallow". It is high in protein, vitamin C, beta-carotene, calcium, and iron. Along with white jute, tossa jute has also been cultivated in the soil of Bengal where it is known as paat from the start of the 19th century. Currently, Bangladesh is the only global producer of white jute variety, However the Bengal region (West Bengal in India, and Bangladesh) is the largest global producer of the tossa jute varieties (Annon., 2007a; Annon., 2011b).

3. Climate

Jute needs a plain alluvial soil and standing water. The suitable climate for growing jute (warm and wet) is offered by the monsoon climate, during the monsoon season. Temperatures from 20°C to 40°C and relative humidity of 70%–80% are favourable for successful cultivation. Jute requires 5–8 cm of rainfall weekly, and more during the sowing period (Dempsey, 1975; Alim, 1978; Islam, 2008; Kundu et al. 1959).

4. Botany

4.1 Jute Taxonomy

Rank	Scientific Name and Common Name
Kingdom	Plantae – Plants
Subkingdom	Tracheobionta – Vascular plants
Superdivision	Spermatophyta – Seed plants
Division	Magnoliophyta – Flowering plants
Class	Magnoliopsida – Dicotyledons
Subclass	Dilleniidae
Order	Malvales
Family	Tiliaceae – Linden family
Genus	<i>Corchorus</i> L. – corchorus
Species	<i>Corchorus olitorius</i> L. – nalta jute <i>Corchorus capsularis</i> L. – white jute
English name	Jute
Bengali name	Pat, Paat, Naila etc.

4.2 Medicinal Species

White Jute (*Corchorus capsularis* L.), and Tossa Jute (*Corchorus olitorius* L.) both the species have medicinal values. 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 strophanthin. Deobstruent, diuretic, lactagogue, purgative, and tonic, tussah jute is a folk remedy for aches and pains, dysentery, enteritis, fever, dysentery, pectoral pains, and tumors (Duke and Wain, 1981; List and Horhammer, 1969-1979). Ayurvedics 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 strength (Duke, 1983; Annon.,).

4.3 Plant Description

Tossa jute (*Corchorus olitorius* L.): Annual or biennial herb, erect, stout, branched, to 1.5 m high; rootstock woody. Leaves lanceolate to ovate-lanceolate, subobtusate at base, serrate at margin with basal most serrations extending into filiform processes, acute at apex, glabrous except sparsely hairy nerves, 3-5 nerved; petioles 2-3 cm long, pubescent; stipules subulate, 8-12 mm long, glabrous. Flowers in 1 or 2 flowered leaf opposed cymes, 12-15 mm across, subsessile; bracts subulate, 4-5 mm long. Sepals linear-oblong, apiculate, 5-7 mm long. Petals oblong-spatulate, obtuse, 5-7 mm long. Stamens numerous, somewhat connate at base. Ovary cylindrical, sparsely hairy, 5-loculed; style short; stigma 5-lobed, minutely papillate. Capsules solitary or paired, subcylindrical, 2-7 cm long, 10-ribbed, glabrous, 5-loculed; locules septate between seeds; beak entire, 4-8 mm long; seeds 3-gonous, ca 2 x 1.5 mm, inconspicuously verrucose, black (Dr. N Sasidharan (Dr. B P Pal Fellow), Kerala Forest Research Institute, Peechi) (<http://indiabiodiversity.org/species/show/229280>) (Dempsey, 1975; Alim, 1978; Kundu et al. 1959).

White jute (*Corchorus capsularis* L.): Annual, much branched, spreading herbs; stems pilose, often reddish. Leaves 2.5-7 x 1.5-3.5 cm, ovate to elliptic-lanceolate, base rounded, margins serrate, the basal pair of serrations ending in setae or not, apex acute, basally 3-5-nerved; petioles upto 3 cm long; stipules 4-8 mm long, setaceous. Flowers 2-3 in leaf-opposed, shortly pedunculate cymes; pedicels c. 2 mm long. Sepals 5, 3-4 mm long, linear-oblong, hooded and apiculate. Petals 5, yellow, 3-5 mm long, obovate, obtuse. Stamens many. Ovary c. 2 mm long, cylindrical, 3-loculed; style 3-fid; stigma 2-lobed. Capsules 1-3 x 0.4-0.6 cm, 6-angled, 3 of the angles winged, 3-loculed. Seeds numerous, dark brown (Dr. N Sasidharan (Dr. B P Pal Fellow), Kerala Forest Research Institute, Peechi) (<http://indiabiodiversity.org/species/show/229281>) (Dempsey, 1975; Alim, 1978; Kundu et al. 1959).

4.4 Geographical Distribution

Jute is grown in Bangladesh, India, Myanmar, Nepal, China, Taiwan, Thailand, Vietnam, Cambodia, Brazil and some other countries. Bangladesh used to enjoy almost a monopoly of this fibre commercially. Although jute is grown in almost all the districts of Bangladesh, Faridpur, Tangail, Jessore, Dhaka, Sirajganj, Bogra, and Jamalpur are considered the better growing areas (Alim, 1978; Islam, 2010; Kundu et al. 1959). Total area under the crop cultivation of Bangladesh in the year 2010 was 708,000 ha and the total production was 8395,000 bales (BBS 2011). On the other hand in India during 2011 area under the crop cultivation was 768,000 ha and the total production was 1799,000 bales (FAO 2011).

5. Jute leaf Biochemistry

Jute leaf is a unique plant part which is a rich source of many chemical compounds and plays an important role in the national and international market. Prof. Tom D. Rowe (1941) was probably first to take vital steps in the chemical analysis of the plant. Jute leaves now reported to contain as many as 17 active nutrients compounds including protein, fat, carbohydrate, fiber, ash, Calcium, Potassium, iron, sodium, phosphorous, beta-carotene, thiamine, riboflavin, niacin, ascorbic acid etc (Islam, 2010; Calleja, 2010).

Leaves contain oxydase and chlorogenic acid. The folic acid content is substantially higher than that of other folacin-rich vegetables, ca 800 micrograins per 100g (ca 75% moisture) or ca 3200 micrograms on a zero moisture basis (Chen and Saad, 1981). This green, leafy vegetable is rich in beta-carotene for good eyesight, iron for healthy red blood cells, calcium for strong bones and teeth, and vitamin C for smooth, clear skin, strong immune cells, and fast wound-healing. Vitamins A, C and E present in Saluyot “sponge-up” free radicals, scooping them up before they can commit cellular sabotage (Chen and Saad, 1981; Duke, 1983).

Table 1. Nutritional values of jute leaves as saluyot (Boiled/100 grams edible portion)
(Annon., 2010; Islam, 2010; Islam, 2012)

Nutrients	Boiled
Moisture (%)	80.4 – 84.1
Food energy (cal.)	43 - 58
Protein (g)	4.5 –5.6
Fiber (g)	1.7 –2.0
Total Carbohydrates (g)	7.6 – 12.4
Ash (g)	2.4
Calcium (mg)	266 - 366

Phosphorus (mg)	97 - 122
Iron (mg)	11.6
Sodium (mg)	12
Potassium (mg)	444
Vit. A (I.U.)	6,390
Thiamine (mg) (Vit.B1)	15
Riboflavin (mg) (Vit.B2)	28
Niacin (mg) (Vit.B3)	1.5
Ascorbic acid (mg)	95

The phytochemical screening of the leaves of capsularis showed the presence of flavonoids, saponins, tannins, steroids and triterpenes. It is also rich in vitamin, carotenoid, calcium, potassium and dietary fiber. *C. capsularis* L. leaves contain two functional compounds; phytol (3,7,11,15-tetramethyl-2-hexadecen-1-ol) and monogalactosyldiacylglycerol (1,2-di-O- α -linolenoyl-3- β -D- galactopyranosyl-glycerol). *C. capsularis* L. also contains capsin, a glycoside, which is responsible for the major bitter taste of the leaves of *C. capsularis* L. ;Another glycoside (capsugenin-30-O- β -glucopyranoside) was also isolated from the leaves of *C. capsularis* L. The capsin was identified as the 3-glucoside of 20, 24-epoxy-3 β , 12 β , 25, 30-tetrahydroxydammarane (<http://www.globinmed.com/>, Furumoto et al., 2002; Meara and Sen, 1952; Zainul et al., 2007; Mosihuzzamana et al., 1982; Quader et al., 1987; Hasan et al., 1984; Mosihuzzaman et al., 1988; (<http://www.pfaf.org/database/plants>; http://www.skeuroltd.bd.com/about_jute.html;<http://www.stuartxchange.org/PasauNaBilog.html>).



Jute plants



Jute plant/ Jute seedling of 30-40 days of age with leaves



Jute leaf packet for marketing



Jute leaf packets for marketing

Figure 1: The jute plant and jute leaf marketing packet

6. Jute leaf's medicinal values and uses

6.1 While perhaps better known as a fiber crop, jute is also a medicinal "vegetable", eaten from Tanganyika to Egypt. Dried leaves were given me by an Egyptian friend who had brought them with him to this country. They are used in soups under the Arabic name "Molukhyia." In 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 strophanthin (Annon., 2011b).

6.2 Reported to be demulcent, deobstruent, diuretic, lactagogue, purgative, and tonic, tussah jute is a folk remedy for aches and pains, dysentery, enteritis, fever, dysentery, pectoral pains, and tumors (Duke and Wain, 1981; List and Horhammer, 1969-1979; Watt, and Breyer-Brandwijk, 1962). Ayurvedics 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 strength (Duke, 1983; Kirtikar and Basu, 1975).

Table 2: Mechanisms of action of jute leaf and its components as medicine

PROPERTIES	MECHANISMS
Antinociceptive/ Antiinflammatory	Study showed the extract of CC exhibited significant antinociceptive and antiinflammatory activities confirming its traditional use for ailments associated with inflammation and pain. It is used traditionally to address concerns related to inflammation and pain. It is also been connected with curing the chronic inflammation of the urinary bladder.
Galactolipid / Anti-Tumor	Galactolipid 1 has been shown to be responsible for the anti-tumor promoting activity of jute (<i>Corchorus capsularis</i> L. and <i>C. olitorius</i> L.).
Antipyretic / Antinociceptive / Antiinflammatory	Study on the aqueous extract of jute plant leaves, <i>C. capsularis</i> L., exhibited significant antinociceptive, anti-inflammatory and anti-pyretic activities in a dose-dependent manner and supports its claim of traditional use to treat various ailments.
Capsugenin	Study yielded a glycoside-capsugenin-30-o-B-glycopyranoside, from the leaves of <i>Corchorus capsularis</i> L.
Headaches, Liver disorders	The powdered leaves, dried, 1 or 1 1/2 tbsps to a cup of water, steep for 3 to 5 minutes, and strain before drinking.
Dysentery, coughs and phthisis, and poulticing sores	Malays use a decoction of the leaves for dysentery, for coughs and phthisis, and as a tonic for children. Also, used for poulticing sores.
Antiseptic	Finely carded fiber sometimes used as base for antiseptic surgical dressings
Acute dysentery	Cold infusion of the leaves as a bitter tonic; used in patients recovering from acute dysentery
Atonic dyspepsia, liver disorders, chronic cystitis, gonorrhoea, dysuria, worms in children, hepatic and intestinal colic, and gastric catarrh.	Infusion of leaves used for atonic dyspepsia, liver disorders and as febrifuge. Also used for chronic cystitis, gonorrhoea, dysuria, worms in children, hepatic and intestinal colic, and for gastric catarrh.
Eyesight	Its vitamin content is good for eyesight, as the vegetable contains beta-carotene.
Swine flu	The Philippine Department of Health advises the public to increase their intake of jute leaf vegetable, to include malunggay and banana as well, in order to build resistance against the threat of swine flu
Carminative, demulcent, laxative, stimulant and stomachic	The leaves are appetizer, carminative, demulcent, laxative, stimulant and stomachic. An infusion is used in the treatment of dysentery, fevers, dyspepsia and liver disorders.

(Sources: (<http://stuartxchange.com/PasauNaBilog.html>, Chopra. R. N., Nayar. S. L. and Chopra. I. C. Glossary of Indian Medicinal Plants (Including the Supplement). Council of Scientific and Industrial Research, New Delhi. (1986-00-00), <http://herbs.indianmedicinalplants.info/index.php/sanskrit-names-of-plants/44-2012-02-24-07-34-36/427--corchorus-capsularis->, <http://www.naturalmedicinalherbs.net/herbs/c/corchorus-capsularis=jute.php>)

6.3 *Corchorus olitorius* L. is a native plant of tropical Africa and Asia, and has since spread to Australia, South America and some parts of Europe. Its leafy vegetable is popularly used in soup preparation and folk medicine for the treatment of fever, chronic cystitis, cold and tumours. A comparative study of the antioxidant properties of hydrophilic extract (HE) and lipophilic extract (LE) constituents of the leafy vegetable has been assessed. HE and LE of the leaf were prepared using water and hexane, respectively and their antioxidant properties were determined. HE had a significantly higher ($P < 0.05$) 1,1-diphenyl-2-picrylhydrazyl radical-scavenging ability (aqueous, 9.6-84.4%; hexane, 2.0-20.4%), reducing power (aqueous, 0.67 mmol ascorbic acid equivalent/g; hexane, 0.49 mmol ascorbic acid equivalent/g) and trolox equivalent antioxidant capacity (aqueous, 2.3 mmol/g; hexane, 1.1 mmol/g) than LE; conversely, LE had a significantly higher ($P < 0.05$) OH. scavenging activity (44.5-46.2%) than HE (11.6-32.3%), while there was no significant difference ($P > 0.05$) in their Fe(II) chelating ability (HE, 57.7-66.7%; LE, 56.4- 61.1%). The higher 1,1-diphenyl-2-picrylhydrazyl radical-scavenging ability, reducing power and trolox equivalent antioxidant capacity of the hydrophilic extract may be due to its significantly higher ($P < 0.05$) total phenol (630.8 mg/100 g), total flavonoid (227.8 mg/100 g) and non-flavonoid polyphenols (403.0 mg/100 g), and its high ascorbic acid content (32.6 mg/100 g). While the higher OH. scavenging ability of LE may be due to its high total carotenoid content (42.5 mg/100 g). Therefore, the additive/synergistic antioxidant activities of the hydrophilic and lipophilic constituents may contribute to the medicinal properties of *C. olitorius* L. leaf (Obboh et al., 2009).

6.4 Research reveals that this plant originated in Egypt and was the source of health and beauty of the Egyptian royalties, including Cleopatra. Due to the high anti-oxidant activity of saluyot, eating it reduces the appearance of wrinkles and fine lines in the face and body. Regular consumption of saluyot can make you appear young (Ali, 2013; healthrecipes.ws, 2010).

6.5 Antinociceptive and anti-inflammatory activity

The chloroform extract of *C. capsularis* L. leaves was investigated for antinociceptive activity using acetic acid-induced abdominal constriction and hot plate tests in male Balb-C mice and the formalin tests in rats. [4] The extract was given 30 minutes prior to subjection to acetic acid-induced abdominal constriction and the hot plate tests. All concentrations used (10, 50 and 100% strength) showed significant reductions in the number of abdominal constrictions when compared to the control. The effective antinociceptive activity was seen at 100 mg/kg of the chloroform extract when compared to acetylsalicylic acid (100 mg/kg). The thermally induced nociceptive peripheral stimulus in male Balb-C mice using the hot plate test at 50°C showed a significant concentration-independent antinociceptive activity in the chloroform extract of *C. capsularis* L. leaves. This activity was observed 30 min after the extract administration compared to morphine (5 mg/kg) which showed significant activity after 1 hour of its administration. These findings revealed the extract's effectiveness in inhibiting chemically and thermally-induced nociception (<http://www.globinmed.com/> Furumoto et al., 2002; Meara and Sen, 1952; Zainul et al., 2007; Mosihuzzamana et al., 1982; Quader et al., 1987; Hasan et al., 1984; Mosihuzzaman et al., 1988; (<http://www.pfaf.org/database/plants>); Ali, 2013; http://www.skeurold.bd.com/about_jute.html; <http://www.stuartxchange.org/PasauNaBilog.html>).

In the formalin test in rats, the chloroform extract of *C. capsularis* L. leaves was given 30 minutes prior to formalin injection. The extract exhibited significant antinociceptive activity at the early phase of nociception, indicating a neurogenic type of pain response, and also at the late phase of nociception, indicating an inflammatory type of pain response. (<http://www.globinmed.com/>).

The anti-inflammatory profile of the chloroform extract of *C. capsularis* L. leaves was measured using carrageenan-induced paw edema test in rats. The extract at all concentrations (20, 50 and 100 mg/kg) caused a significant decrease in the thickness of edematous paw for the first 6 hours compared to the control. The activity diminished in the last 2 hours of the experimental time compared to the control group (<http://www.globinmed.com/>).

The positive reference compound used was acetylsalicylic acid (100 mg/kg) which produced significant anti-inflammatory activity. This test revealed the ability of the extract to block the inflammatory phase of the formalin test, which confirmed the folkloric use of *C. capsularis* L. as a demulcent (<http://www.globinmed.com/>).

Based on all of these findings, the chloroform extract of *C. capsularis* L., possessed antinociceptive and anti-inflammatory activities which confirmed the traditional claims of using *C. capsularis* L. to treat various ailments related to inflammation and pain (Furumoto et al., 2002; Meara and Sen, 1952; Zainul et al., 2007; Mosihuzzamana et al., 1982; Quader et al., 1987; Hasan et al., 1984; Mosihuzzaman et al., 1988; (<http://www.pfaf.org/database/plants>); http://www.skeurold.bd.com/about_jute.html; <http://www.stuartxchange.org/PasauNaBilog.html>).

6.6 Antitumor promoting activity

Two active components of *C. capsularis* L. were identified. These components showed activity against tumor promoter-induced Epstein-Barr virus (EBV) activation in Raji cells. They were isolated from the fresh leaves of *C. capsularis*. The active components were colorless oils and were identified as phytol (3,7,11,15-tetramethyl-2-hexadecen-1-ol) and monogalactosyl-diacylglycerol (1,2-di- α -linolenoyl-3- β -D-galactopyranosyl-glycerol) (<http://www.globinmed.com/>).

The antitumor-promoting activity was examined by an immunoblotting analysis using a mouse antiserum against EBV producer P3HR-1 cells. Phytol and monogalactosyldiacylglycerol completely inhibited the induction of EBV early antigen at concentrations of 15 μ g/mL (50.7 μ M) and 30 μ g/mL (38.8 μ M), respectively. However insufficient inhibitory effects were shown by both compounds at concentrations of 10 μ g/mL and 25 μ g/mL, respectively (Furumoto et al., 2002; Meara and Sen, 1952; Zainul et al., 2007; Mosihuzzamana et al., 1982; Quader et al., 1987; Hasan et al., 1984; Mosihuzzaman et al., 1988; (<http://www.pfaf.org/database/plants>); http://www.skeurold.bd.com/about_jute.html; <http://www.stuartxchange.org/PasauNaBilog.html>).

This study also revealed that both components increased gradually with an increasing in the period of treatment with hot water, indicating that the components were not easily decomposed by high temperature. These findings suggest that treatment of vegetables with hot water effectively increased the amount of active components with activity against tumor-promoting chemicals that may be consumed together with food (<http://www.globinmed.com/>).

7. Use of jute leaf as food/vegetable diet

Jute leaves are consumed in various parts of the world. It is a popular vegetable in West Africa. The Yoruba of Nigeria call it "ewedu". The Hausa people of Nigeria and their Fulbe neighbours call it "rama." They use it to produce soup ("taushe") or boil the leaves and mix it with "Kuli-kuli" or groundnut cake and consume the mixture which they call "kwado" in Hausa. The Hausa peasant farmers cultivate it beside their corn-stalk constructed homesteads or among their main crops in their farms. There are commercial jute farmers in Northern and South Western Nigeria. They (jute commercial farmers) have a strong National Association registered by the authorities. In Northern Sudan it's called "Khudra" meaning green in Sudanese Arabic. The Hausa and Fulbe peoples also use jute leaves to treat some diseases. And the Songhay of Mali call it "fakohoy" whereas Tunisians call it mulukhiyah. It is made into a common mucilaginous (somewhat "slimy") soup or sauce in some West African cooking traditions, as well as in Egypt, where it is called mulukhiyya, Cypriots call it molocha - and that refers to food - in terms of fibre this would be unknown - and it is sometimes eaten as boiled vegetable with lemon and olive oil. It is also a popular dish in the northern provinces of the Philippines, where it is known as saluyot. Jute leaves are also consumed among the Luyhia people of Western Kenya, where it is commonly known as 'mrenda' or 'murere'. It is eaten with 'ugali', which is also a staple for most communities in Kenya (<http://en.wikipedia.org/wiki/Jute>; Islam, 2006).

Young fresh leaves eaten as vegetable in various parts of the world - Bangladesh, Middle East, Africa, SE asia. In Bengal, where it is considered a tonic, leaves are used as a condiment, commonly added to the daily diet of rice. In Japan, considered a health food item, dried leaves sometimes used as a substitute for coffee and tea. Leaves sometimes used as condiment. In Rumpf's time, when slaves from India were detained in Amboina, there was much use for it as vegetable (<http://stuartxchange.com/PasauNaBilog.html>; Islam, 2006).

After irradiation, a dwarf mutant CM-18 with more number of leaves has been selected. The mutant CM-18 was selected out for its higher leaf yield. Then it was tested in farmers' fields. Fresh twigs (edible portion) of 30 days old seedling of both the genotypes were analyzed for Protein, Fiber, Alkaloid, Carotene and Vitamin C. The mutant line CM-18 produced 32 per cent higher twig yield than its parental variety CVL-1. Qualitative characters compared with its parental variety CVL-1 are shown below: The mutant CM-18 contains higher protein and carotene contents than parent variety. Fiber, Alkaloid and Vitamin C contents are more or less similar with CVL-1. Low alkaloid contained in leaves make it tasty. The mutant CM-18 has high vegetable yield potential, protein and carotene content. Due to better performance in respect of yield and quality the mutant CM-18 has been registered as the first jute variety in Bangladesh for vegetable purpose in the name of Binapatshak-1 in 2003.

Corchorus leaves are consumed in the cuisines of various countries. Corchorus olitorius is used mainly in the cuisines of southern Asia, the Middle East, and North Africa, Corchorus capsularis in Japan and China. It has a mucilaginous (somewhat "slimy") texture, similar to okra, when cooked. The seeds are used as a flavouring, and a herbal tea is made from the dried leaves. The leaves of Corchorus are rich in betacarotene, iron, calcium, and vitamin C. The plant has an antioxidant activity with a significant α -tocopherol equivalent vitamin E.

In North Africa and the Middle East, the young leaves of Corchorus species are known in Arabic as malukhiyah and are used as green leafy vegetables. Malukhiyah is eaten widely in Egypt and some consider it the Egyptian national dish. It is featured in cuisines from Lebanon, Palestine, Syria, Jordan and Tunisia. In Turkey and Cyprus, the plant is known as molohiya or molocha and is usually cooked into a kind of chicken stew. The leaves of Corchorus have been a staple Egyptian food since the time of the Pharaohs and it is from there that it gains its recognition and popularity. Varieties of mallow-leaves stew with rice is a well known Middle Eastern cuisine (Annon., 2011b; Islam, 2006; Whitlock et al. 2003).

In Nigerian cuisine, especially amongst the Yorubas, it is commonly used in a stew known as ewedu, a condiment to other starch-based foods such as amala. The Hausa people of Nigeria and their Fula neighbours call it rama. They use it to produce soup (taushe) or boil the leaves and mix it with kuli-kuli (groundnut cake) to form a dish known as kwado in Hausa. The Hausa peasant farmers cultivate it beside their corn-stalk constructed homesteads or among their main crops in their farms. The Hausa and Fulbe peoples also use jute leaves to treat some diseases. In Sierra Leone it is known as krain krain (or crain crain) and is cooked as stew. The stew is usually eaten with rice or foofoo (a traditional food made from cassava). Jute leaves are also consumed among the Luhya people of Western Kenya, where it is commonly known as mrenda or murere. It is eaten with starchy foods like ugali, a staple for most communities in Kenya. In Northern Sudan it is called khudra, meaning "green" in Sudanese Arabic. The Songhai people of Mali call it fakohoy. In India, it is locally known as nalta sag. It is a favorite food during the summer months, especially in Sambalpur and the western part of Odisha. Usually it is lightly sauteed and eaten along with rice or rice gruel. In the Philippines, C. olitorius is known as saluyot. It is commonly consumed as a leafy vegetable together with bamboo shoots. In Thai cuisine, the leaves of the Corchorus olitorius L. (locally known as bai po; Thai: ใบปลู) are eaten blanched, together with plain rice congee. The taste resembles that of spinach and samphire (Islam, 2005; Islam, 2006).

Because the saluyot or jute plant is by nature a vegetable, it is easy to prepare and can be incorporated to various dishes that would allow individuals to benefit from its vitamins and mineral content. Since it can be found easily, there are a lot of local viands and/or dishes that use saluyot as an ingredient. For instance, the Ilocanos use saluyot in their preparation of dinengdeng and bulangbulang. Fried saluyot are also mixed with sautéed bamboo shoots and dried beans. Other dishes include, but are not limited to chicken viands, wherein saluyot are mixed in either sautéed or pureed form. It is also integrated in mongo dishes, and in soups. (<http://rullanamador.blogspot.com/2010/01/saluyot-or-jute-corchorus-capsularis-l.html>; Hepzibah, 2008; Islam, 2006).

The leaves of *C. capsularis* L. have been claimed to possess stimulant, demulcent, laxative, appetizer and stomachic effects. The infusion of the leaves is traditionally used to treat fever, constipation, dysentery, liver disorders and dyspepsia. In Japan, the young leaves were used as a substitute for coffee or tea and were regard as a health food (<http://www.globinmed.com/>).

Comparison study of jute leaf with spinach

Like spinach and other leafy greens, jute leaves can be cooked whole as a major component of a dish, or can be loosely chopped so that they blend better with other ingredients. Some cooks like to salt their jute leaves and rest them before cooking, to draw out some of the slime which can make them troubling to the palate. The longer jute leaves cook, the more slimy and dense they get, so it is important to pay attention to cooking times in recipes which call for jute leaves. Ingredients comparison of jute leaf with leafy vegetable spinach is given below-

Table 2. Nutritional comparison between jute leaf and spinach (per 100 gm each), (Annon., 2010; Islam, 2010)

Ingredients and unit	Spinach leaf	Jute leaf
Calories (kl cal)	25	73
Protein (g)	3.3	3.6
Lipid (g)	0.2	0.6
Calcium (mg)	55	298
Iron (mg)	3.9	11
Carotene (mg)	5200	6400
Vitamin B-1 (mg)	0.13	15
Vitamin B-2 (mg)	0.23	28
Vitamin C (mg)	65	64

Pesticide use in biotic areas

Jute leaves contain Hydrogen cyanide (HCN) and several cardiac glycosides. Negm et al. (1980) report the LD50 of issue extracts to mice. The "lethal dose" of Corchoroside A to cats is 0.053-0.0768 mg/kg and Corchoroside B 0.059-0.1413, but some authors say that Corchoroside A is twice as active as Corchoroside B (Duke, 1983).

Anthraxnose spots caused by *Colletotrichum gloeosporioides* may infect 50-90% of a jute population, but spraying with copper oxychloride at 0.5% strength checked the spread, holding it to 5-10%. This species was badly infested by 3 species of weevils (*Myllocerus* spp.) while *C. capsularis* L. was unaffected. The semilooper (*Anomis sabulifera*) may stunt the growth, reducing fiber yields by ca 13-32%. The yellow mite, (*Polyphagotarsonemus latus*) may also reduce yields (Duke, 1983).

Conclusion

There are so many jute and allied fibre crops varieties developed, released and used at farmers' level for commercial cultivation. All those varieties leaves have both vegetable and medicinal values. Jute leaf has long been used as a remedy in many cultures. The jute leaf contains over 17 active nutrient compounds including many minerals, amino acids and vitamins. Today, this multiutility versatile plant part is considered to cure Mankind's different health problems. There are many natural medicinal herbs, but jute leaf is granted with vast array of healing benefits. Although, jute leaf has wide spectrum of the properties and uses. Jute leaf contains protein, calories, fibres and as well as antitumor promoters; Phytol and Monogalactosyl-diacylglycerol. It may reduce risk of cancer. Therefore jute leaf has a great importance in terms of human nutrition, health and beauty care. In future, controlled studies are required to prove the effectiveness of jute leaf under the various conditions.

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