

Chemical Constituents and Protection of Biodiversity of *Corypha taliera* Roxb., a Critically Endangered Plant of Bangladesh

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Abstract

This article focuses on the chemical constituents and protection of biodiversity through plantation of saplings of *Corypha taliera* Roxb., a critically endangered plant of Bangladesh. Until 2010, the tree in the campus of University of Dhaka, used to be considered as the lone surviving species in the world in nature. Successive chromatographic separation and purification of the methanol extract of air dried flowers of *C. taliera* provided β -sitosterol (**1**), β -amyrin (**2**), and betulinic acid (**3**) for the first time from its flowers. The structures of these purified compounds were established by extensive spectroscopic analysis and comparison of spectral data with published values as well as co-TLC with authentic samples. On the other hand, 500 mature seeds were sown in seed beds in the Medicinal Plant Garden of Faculty of Pharmacy, University of Dhaka, and Azimpur Government Officers' Quarter premises. After 40 days, the root was first seen to grow in its habitat and 85 days later the shoot developed up to 2.5 cm in height. The rate of germination was found to be 89-93%. The produced saplings were later on planted in different places of Bangladesh for conservation of the plant and protection of biodiversity by *ex situ* arrangement.

Key words: *Corypha taliera*, biodiversity, chemical constituents, plantation.

Introduction

Bangladesh is endowed with nearly 5000 floral species where 546 have been identified with significant medicinal values (Yusuf *et al.* 1994). However, 12.75 % of vascular species (dicotyledons, monocotyledons, pteridophytes, angiosperms, and gymnosperms) of these plants are facing a greater risk of extinction because of threatened biodiversity (Irfanullah, 2011). Plantation is essential for the protection of biodiversity and recuperation of floral species. More desirable biodiversity consequences are anticipated with plantations that make use of indigenous tree species. Plantations ensures habitat for threatened floral species, stipulating the necessity to combine conservation plans of action into control strategies (Bremer and Farley, 2010).

Bangladesh National Herbarium (BNH) has recorded over 100 endangered angiosperm species in Bangladesh (Khan, 1991). *C. taliera*, a palm tree of Arecaceae family, is one of the endangered angiosperms of Bangladesh. It is locally known as Talipalm. It was first identified by William Roxburgh in 1819 and found to be endemic in Bengal. It is also reported as an endangered species in the whole world (Shoeb *et al.*, 2015). The last specimen of the plant was standing within the campus of the University of Dhaka, Bangladesh which was found to extinct in 2010 after one time flowering and fruiting (Basu and Chakraverty 1994; Khan *et al.*, 2001; Shoeb *et al.*, 2015).

Significant evidence regarding economic value, botanical information including panicle initiation,

flowering and fruiting as well as biochemical composition of flowers and fruits of the plant have been recorded primarily (Shoeb *et al.*, 2015; Khondker *et al.* 2010). Recently, phytochemical screening revealed that the unripe fruits contain significant bioactive molecules including β -sitosterol, β -amyrin, betulinic acid, lupeol (Chowdhury *et al.*, 2013), palmitic, myristic, linoleic, arachidic, stearic, lignoceric acids (Shoeb *et al.*, 2013) and β -sitosterol-3-O- α -L-rhamno-pyranosyl-(1 \rightarrow 4)- β -D-xylopyranosyl-(1 \rightarrow 4)- β -D-glucopyranosyl-(1 \rightarrow 4)- β -D-glucopyranoside (Shoeb *et al.*, 2015). Bioactivity assays of the extractives of the plant revealed its promising antioxidant and cytotoxic properties and mild to moderate activity against pathogenic microorganisms (Chowdhury *et al.*, 2010). The chemical potential of betulin, an isolated compound of the plant, has been characterized through computational study (Khan *et al.*, 2017). These outcome sprovided significant insights of the medicinal value of the plant and imposed researchers for its preservation and propagation. Efforts to raise the numbers of *C. taliera* populations require adequate knowledge of the fundamental biology of the species concerning the environmental circumstance for germination and propagation (Baskin and Baskin, 2003). Therefore, the present studies were focused on isolation and characterization of compounds from flowers of *C. taliera* and its propagation through sapling plantation all over Bangladesh to shed light towards its conservation.

Materials and Methods

Collection and identification of plant materials: After identification of the plant by Prof. Salar Khan within the campus of University of Dhaka in 1950, it was kept under close observation. In 2001, Bangladesh National Herbarium, Mirpur, Dhaka published a feature to their Red Data Book with picture of the tree (Rao, 2004). Then the tree was able to draw wide attention of the people, who waited to see the plant blooming. A voucher specimen including leaf, flower, fruit, and the seed of

the plant (accession no: DACB-34180) has been deposited in Bangladesh National Herbarium, Dhaka.

Collection and extraction of flowers: Flowers of the plant were collected during February to March, 2009. The air-dried flowers (250 gm) of *C. taliera* was extracted with methanol at room temperature for 7 days with occasional shaking and stirring and filtered through a cotton plug followed by Whatman filter paper number 1. Evaporation of solvent using a rotary evaporator yielded 5.5 gm of crude mass. A portion of the concentrated methanol extract was fractioned by the modified Kupchan partitioning method (VanWagenen *et al.* 1993). Successive chromatographic separation and purification of its *n*-hexane soluble fraction yielded a sterol (**1**), and two triterpenoids (**2**, **3**).

Collection of seeds: In January 2010, when the ripe fruits began to fall down quickly, about 500 hundred fruits were collected from the ground and the pericarps were separated carefully from the seeds. Then, the seeds were collected from ripe fruits by taking off the pericarp.

Germination: The separated seeds (300) were sown in seedbed of the Medicinal Plant Garden, Faculty of Pharmacy, University of Dhaka(23°43'40.3" N and 90°23'55.6" E) and another 200 seeds were sown in a seedbed in Azimpur Government Officers' Quarter premises of Dhaka(23°43'56.9" N and 90°23'12.3" E) during January to February 2010 and water supply was ensured regularly. The number of seed sown, the time taken for germination, total number, and percent of germination were recorded carefully.

Propagation: The germinated seed saplings were allowed to grow for 2-3 months. The mature saplings were subjected to plantation from July-August, 2010 by *ex-situ* arrangements and plantation in major locations continued until 2016-2017. They were planted in selected places of Bangladesh (Table 1). Growth, irrigation, pathogenic infections of the saplings of the plant have been closely monitored to ensure their survival, propagation, and conservation.

Results and Discussion

The present study revealed the isolation and characterization of compounds from methanol extract of flowers of *Corypha taliera* (tali palm), including germination and propagation in order to protect the biodiversity. The tali palm provided three compounds characterized as β -sitosterol (**1**) (Jahan et al., 2010), β -amyryn (**2**) (Parvin et al., 2009) and betulinic acid (**3**) (Chandramu et al., 2003) (Figure 1). Although all of these compounds have been isolated from the unripe fruits (Chowdhury et al., 2013), while β -sitosterol and a steroidal glycoside have been reported from the pericarp (Soheb et al., 2013, 2015), it is important to note that compounds **1-3** are the first report of their occurrence from the flowers of *C. taliera*. The solitary tree in the

University of Dhaka campus, was endemic to Bengal and in the absence of any other record used to be considered as the only individual of *C. taliera* species in the wild in its natural state. Obviously, it was the last specimen of that plant in the world which warned the scientific community for its plantation and protection of biodiversity. After long waiting near about hundred years, the tree showed a gigantic flower-stalk sprouted from top of the tree in September 2008. The flower of the plant was first seen during late October, 2008. The full blooming of flowers from the flower-stalk was observed in January 2009. It required almost 40 days for first flowering after the initiation of flower-stalk of the plant.

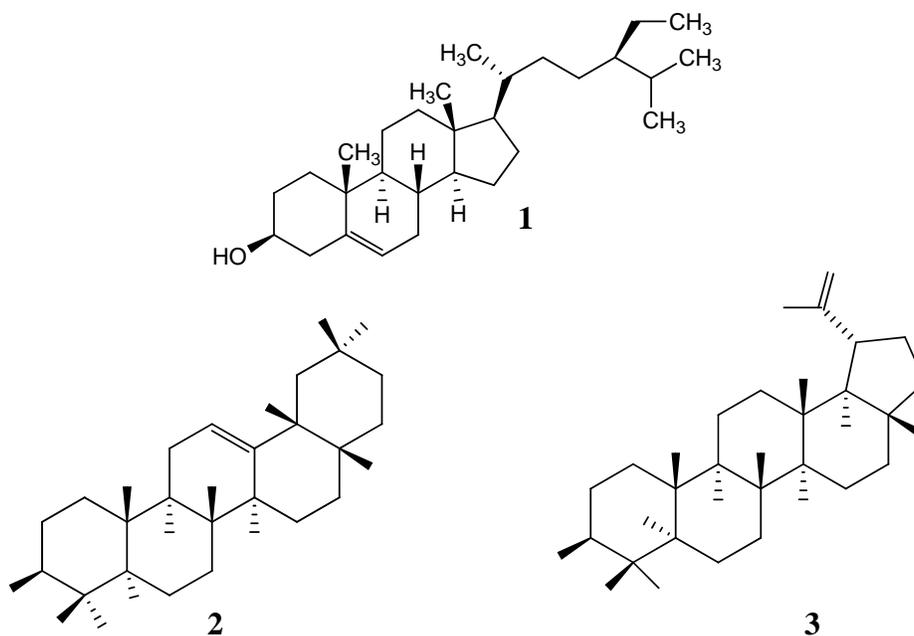


Figure 1. Structure of compounds (**1-3**) isolated from flowers of *C. taliera*.

From the first flowering to fully mature and ripe, the fruits took near about 450 days and the ripen fruit finally began to drop down in January 2010. The seeds were collected by removing the pericarp and then sown. After sowing the seeds in February, 2010 it was observed that, a seedling grew with root which

was about 3cm long (Figure 2A-D and 3A). Out of 300 and 200 seeds sown seeds in the mentioned seed beds, 279 and 178 seedlings were germinated, respectively. The rate of germination was very high (89-93%). The 2-leaved phase (Figure 3B) of seedlings was observed and growth of seedlings was

Table 1. Locations of plantation of saplings of *C. taliera* in Bangladesh.

Sl. No.	District	Site of plantation
1.	Dhaka	Medicinal Plant Garden, Faculty of Pharmacy, University of Dhaka
2.		Asiatic Society of Bangladesh
3.		Tower Bhaban, Fuller Road, University of Dhaka
4.		Kabi Nazrul Government College
5.		Government Shaheed Suhrawardi College
6.		Dhaka College
7.		Dhaka Residential Model College
8.		Government Bangla College, Mirpur
9.		National Botanical Garden
10.		Bangladesh Atomic Energy Commission
11.		Bangla Academy
12.		Bangladesh Council of Scientific and Industrial Research (BCSIR)
13.		Baldha Garden
14.		Dhamrai Government College
15.		Eden Mohila College
16.		Jahangirnagar University
17.		Notre Dame College
18.		Lalbagh Fort
19.	Manikgang	Government Debendra College
20.	Jhenaidah	Jhenaidah Municipality
21.		Jhenaidah Cadet College
22.	Jessore	Jessore Cantonment College
23.	Satkhira	Satkhira Government College
24.	Khulna	Government B. L. College
25.	Meherpur	Meherpur Government College
26.		Meherpur Government Mohila College
27.		Meherpur Municipality
28.	Moulvibazar	Moulvibazar Government College
29.		Moulvibazar Government Women's College
30.	Sylhet	Murari Chand (MC) College
31.	Gajipur	Bhawal Badre Alam Government College
32.		Nuhash Polli
33.	Narsingdi	Narsingdi Government College
34.	Rajshahi	Rajshahi University of Engineering & Technology (RUET)
35.		University of Rajshahi
36.	Bogra	Govt Azizul Haque College
37.	Mymensingh	Ananda Mohan College
38.		Bangladesh Agricultural University
39.	Netrakona	Netrakona Government College
40.		Netrakona Government College

Sl. No.	District	Site of plantation
41.		BIRISHIRI
42.	Sherpur	Sherpur Government College
43.		Sherpur Government Mohila College
44.	Comilla	Comilla Victoria Government College
45.		Comilla Government Women's College
46.	Brahmanbaria	Brahmanbaria Government College
47.		Brahmanbaria Government Mohila College
48.	Barisal	Barisal Cadet College
49.	Noakhali	Noakhali Government College
50.	Kustia	Kushtia Government College
51.	Cox's Bazar	Cox's Bazar Government College



Figure 2. Germination of stages of seed of *C. taliera* (A) sown seed, (B) germinated seed with shoot, (C) seeds (D) pre-matured sapling.



Figure 3. Plantation and maturation of seed saplings of *C. talierain* seed bed (A) sapling with single leaf (B) twig of a sapling after plantation in seed bed (C) matured saplings in a seed bed of Medicinal Plant Garden, Faculty of Pharmacy, University of Dhaka (D) matured saplings in a seed bed of Azimpur Government Officers Quarter premises.

seedlings was determined as 15 cm after 37 days. When the saplings of *C. taliera* were about 2-3 months old (Figures 3C and D), proper attempts were taken to plant them in different places of Bangladesh

(Table 1, figure 4A-D) for the conservation of the plant by *ex situ* arrangement. So far we have been able to complete plantation in more than 100 locations.



Figure 4. Plantation of *C. taliera* in selected sites. A. *Corypha taliera* in BIRISHIRI, Netrokona. B and C. *Corypha taliera* in Medicinal Plant Garden of Faculty of Pharmacy, University of Dhaka. D. *Corypha taliera* in front of 2nd Science Building, Rajshahi University, Rajshahi.

It is clearly evident that *C. taliera*, which was thought to be extinct, now exists in reasonably growing stage in many locations of Bangladesh. It is also established that careful and timely efforts by the

scientists have made conservation of *C. taliera* successful and there is no wove risk of loss of biodiversity due to its extinction.

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