Scholars Academic Journal of Pharmacy (SAJP) **ISSN 2320-4206 (Online)**
Sch. Acad. J. Pharm., 2014; 3(1):19-25 **ISSN 2347-9531 (Print)**

(An International Publisher for Academic and Scientific Resources)
www.saspublisher.com

Review Article

A Comprehensive Ethno-pharmacological and Phytochemical Update Review on Medicinal Plant of *Terminalia arjuna* Roxb. of Bangladesh

Fatema Binte Hafiz[1], Nayeem Md. Towfique[1], Monokesh Kumer Sen[1], Shamima Nasrin Sima[2], Bably Sabina Azhar [3], M Mizanur Rahman[1*]

[1]Department of Biotechnology and Genetic Engineering, Islamic University, Kushtia-7003, Bangladesh
[2] Department of Botany, University of Rajshahi, Rajshahi, Bangladesh
[3]Department of Applied Nutrition and Food Technology, Islamic University, Kushtia- 7003, Bangladesh

***Corresponding author**
Dr. Md. Mizanur Rahman
Email: mmrahmanbtg79@hotmail.com

Abstract: This review paper focused on ethno-pharmacological uses and phytochemical constituents of *Terminalia arjuna* Roxb., an important medicinal plant of Bangladesh, used in various indigenous system of medicine. This review has been conducted to pile up information that is available in different scientific literatures. It is observed that a large number of phytochemical components have been obtained from the plant e.g. arjunin, arjunetin, gallic acid, terminic acid, pyrocatechols, luteolin, β-sitosterol, calcium, magnesium, zinc, copper and these components exhibit various medicinal and pharmacological activities such as anti-mutagenic, anti-bacterial, anti-viral, anti-oxidant, anti-inflammatory, anti-atherosclerotic, anti-diabetic etc. The present comprehensive update review is therefore, an effort to give detailed information on phytochemical and pharmacological studies of *T. arjuna* Roxb. and this information will help the researchers to carry out research on this pharmaceutically important medicinal plant.
Keywords: Ethno-pharmacological activity, T. arjuna Roxb., scientific literatures, systematic study.

INTRODUCTION

After decades of serious obsession with the modern medicinal system, people have started looking at the ancient healing systems like Ayurveda, Siddha and Unnani because of their less adverse effects combined with lower cost that are associated with synthetic drugs [58]. These drugs play an important role in health care programs especially in developing countries. For the treatment of different diseases, about 80% people in the world still rely on conventional medicine [43]. Therefore, the valuation of rich heritage of conventional medicine is essential [64, 46, 55, 57]. The use of therapeutic plant either as a single drug or in combination is increasing in the health care of human being. Phytomedicines or botanical medicines refer to the use of bark, seeds, root, berries, leaves, or flowers of any plant for therapeutic purposes by large number of people. It has now been recognized that the plants which naturally accumulate and synthesis some secondary metabolites like glycosides, alkaloids, tannins, volatiles oils and contain vitamins and minerals, possess medicinal properties [26].

The scientific name of arjun is *Terminalia arjuna* Roxb. It is about 60-80 feet height perennial tree found everywhere in Bangladesh. It is composed of enormous active constituents include glycosides, tannins, flavonoids, triterpenoids, β-sitosterol and minerals [47] which possesses high therapeutic value and traditionally used for the treatment of different ailments for human beings. The bark extract of *T. arjuna* Roxb. is considerably prevented the isoprenaline-induced increase through oxidative stress, decrease in endogenous antioxidant level and also avoid fibrosis without increasing the heart weight and body weight ratio, as well as it can prevent myocardial changes induced by the action of chronic beta-adrenoceptor stimulation [35]. The bark is anti-dysentric, cardiotonic, lithotriptic, antipyretic, astringent, and tonic while the powder of the bark acts as a diuretic in cirrhosis of liver and gives relief in symptomatic hypertension [11]. In studies in mice, the leaves of *T. arjuna* Roxb. have been shown to have anti-inflammatory and analgesic properties [47]. It may also be useful in treating hypercholesterolemia by reducing LDL levels [41]. The bark powder has been found to possess cardioprotective properties, anti-ischaemic, antioxidant action [54], hypocholesterolaemic effect, fungicidal [36], anti-microbial [65], anti-bacterial, anti-fertility, treatment of ulcers, skin disorders and as antidote to poisons. It is also useful to cure obesity, hypertension and hyperglycemia [44]. The bark constituents are promising in anti-mutagenic and anti-carcinogenic potential [53, 63, 32, 61, 56].

The aim of this present study was to deliver valuable information on phytochemical and pharmacological characteristics of *T. arjuna* Roxb. This compendium review also includes its taxonomy, monograph,

morphology, and distribution of this highly significant medicinal plant.

Taxonomy of *T. arjuna* Roxb.

Medicinal plants are characterized according to the habit, habitat, part used, therapeutic value etc., besides the usual botanical classification. But botanical classification is the most scientific classification and comprehensive. The botanical classification of *T. arjuna* Roxb. is as following:

Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Myrtales
Family	Combretaceae
Genus	*Terminalia*
Species	*T. arjuna* Roxb. [54]

Chromosome number of *T. arjuna* Roxb.

The chromosome number of *T. arjuna* Roxb. is n=2 [44].

Plant parts of *T. arjuna* Roxb. used as medicinal purposes or medicines

Its fruit, root bark, seeds root, leave and mostly barks are useful in the medicinal purposes [57]

Monograph of *T. arjuna* Roxb.

- Bengali name: Arjun, Arjhan [43].
- English name: Arjun terminalia, White murda, Tropical almond, Malabar almond [43].
- Botanical name: *T. arjuna* Roxb.
- Family: Combretaceae [35, 36, 62].
- Duration: Perennial.
- Growth habit: Tree.
- Native: Bangladesh, India, Sri Lanka [43].

Morphology of *T. arjuna* Roxb.

- Tree is about 60-80 feet in high, large, drooping branches and evergreen with a spreading crown [44].
- Leaves are simple, borne sub-opposite coriaceous, often crenulating, oblong or elliptic.
- Petioles are 6-10 mm long with one or usually two prominent glands at the top, immediately below the leaf. This is a unique pharmacognostic feature of *T. arjuna* Roxb. [32].
- Panicles are small, apical and when young, it is light green and when it is mature, then turns into their color.
- Stems are buttressed and often fluted.
- Bark is thick, soft and smooth gray, red color from inside, irregular sheets, curved and rather flat pieces [60].
- Flowers are white or yellowish and found in groups.
- Calyx is glabrous.
- Fruit is a drupe, 2.5-5 cm long, ovoid or oblong, fibrous-woody, smooth-skinned with five hard angles or wings [32].
- Seeds are hard germination 50-76 days [50-60%].
- Odour is characteristic.
- Taste is bitter.
- Root is superficial, shallow and spreads radially along stream banks.

Distribution of *T. arjuna* Roxb.

T. arjuna Roxb is a deciduous tree found in dry hill areas by the side of water bodies- ravines, streams and rivers. It is abundance throughout Bangladesh, Madhya Pradesh, Indo-sub-Himalayan tracts of Uttar Pradesh, Delhi, and South Bihar. It is also found in forests of Sri Lanka, Burma and Mauritius [65].

Phytochemical studies of *T. arjuna* Roxb.

The chemical constituents of *T. arjuna* Roxb. are shown in Table 1. The whole plant of *T. arjuna* Roxb contains tannins, triterpenoid, flavonoids, saponins, gallic acid, ellagic acid, OPCs, phytosterols, zinc, copper, calcium, magnesium etc. It also contains oleanolic, arjunic acids, arjunoside I, II, arjunolic acid, 8-hydroxyl hexadecanoic, and β-sitosterol.

Table 1: Major chemical constituents of various parts of *T. arjuna* Roxb.

Plant part	Chemical constituents	References
Stem bark	Triterpenoids: arjunolic acid, arjunic acid, arjunin, *arjungenin, **terminic acid	[53]; *[60]; **[5]
	Glycosides: arjunetin, *arjunoside II, *arjunoside I, **arjunaphthanoloside, ***terminoside A	[61, 54]; *[31]; **[1]; ***[2]; [62]
	β-Sitosterol	[5]
	Flavonoids: arjunone, bicalein, arjunolone, *luteolin, ethyl gallate, gallic acid, kempferol, pelorgonidin, quercetin, oligomeric proanthocyanidins	[62]; *[2]; [6]
	Tanins: terflavin C, castalagin, punicallin, casuarinin, punicalagin, terchebulin, casuariin, pyrocatechols	[36, 65, 44]

	Trace elements/Minerals: zinc, copper calcium, aluminium, silica, magnesium	[37]
Roots	β-Sitosterol	[5]
	Triterpenoids: terminic acid, arjunic acid, oleanolic acid, arjunolic acid	[5]
	Glycosides: arjunoside I, arjunoside II, arjunoside III, arjunoside IV, *2,19-dihydroxy-3-oxo-olean-12-en28-oic acid 28-O-d glucopyranoside	[4, 3]; *[44]
Leaves and fruits	Glycosides	
	Flavonoids: luteolin	[63]
Note: *, ** and *** denote corresponding reference for the constituent.		

Folk remedies and traditional uses of *T. arjuna* Roxb.

In Bangladesh, *T. arjuna* Roxb. are used for the treatment of diabetics without using any modern diagnostic procedures by Kabirajes and local people [8, 56]. Bark of *T. arjuna* Roxb. is useful in diseases of the heart, dysentery, asthma, hypertension, menstrual problems, anaemia, wounds and pains. It also stops bleeding and pus formation in the gums [56]. The bark of *T. arjuna* Roxb. is soaked in water and the water is taken once daily on an empty stomach for 4 days for dysentery and 41 days for low sperm count. 50g powder obtained from dried leaves is taken with 20g sugar twice daily for heart disease [58].

Pharmacology of *T. arjuna* Roxb.

Following the traditional and folk uses of *T. arjuna* Roxb, it has been scientifically investigated about the potential of the plant in cure of different ailments. The pharmacological activities of *T. arjuna* Roxb are mentioned in Table 2. It may be used to treat diabetics, heart diseases as well as for the treatment of wound. It has also antiviral, antibacterial, anticancer properties [63, 65].

Table 2: Various pharmacological activities of *T. arjuna* Roxb.

Activity	Plant part used	Animal model	Observations	References
Anti-atherosclerotic	Orally administered indigenous drug	Rabbits	Partial inhibition of rabbit atheroma indicating antiatherogenic role	[61]
Antibacterial	Acetone, hexane and dichloromethane from leaf extract	Human pathogens *E. coli*, *P. aeruginosa*, *B. subtilis*, *S. aureus* and *S. epidermidis*	Exhibit antibacterial activity	[63]
Anti-cancer	Arjunic acid isolated from bark	Human oral [KB], ovarian[PA 1] and liver [HepG-2, WRL-68] cancer cell lines	Treated as anti-cancer treatment	[59]
	Aqueous extract of *T. arjuna*	Lymphoma bearing mice	Down regulation of anaerobic metabolism by inhibiting the activity of lactate dehydrogenase and reducing the oxidative stress leading to anti-carcinogenic activity	[65]
Antidiabetic	Ethanol extract from stem bark	Liver and kidney tissues of diabetic rats	Exhibit the antioxidant activity through correction of oxidative stress and validates the traditional use of this plant in diabetic animals	[59]
Anti-inflammatory	Bark powder	Carrageenan-induced rat paw edema	Prevention of inflammation	[29]
Antioxidant	Casuarinin extracted from *T. arjuna*	Madin-Darby canine kidney [MDCK] cells	H_2O_2 induced oxidative stress, decreases DNA oxidative damage	[41]

Antimutagenic	Tannin fraction	*Salmonella typhimurium*	Inhibit the mutagenicity of 2-aminofluorene in Ames assay	[35]
Antiviral	Casuarinin isolated from the bark	Herpes simplex type-2 *in vitro*	Inhibit viral attachment, penetration and also disturbing the late event of infection	[34]
Cardiovascular activity	Aqueous extract of bark	Rats	Prevent myocardial changes induced by chronic beta-adrenoceptor stimulation	[54]
Gastric activity	Methanol extract	*Helicobacter pylori* lipopolysaccharide induced gastric damage in rats	Anti-ulcer effect damage the gastric mucosa and protect the mucosal defensive factors	[19]
Hepatoprotective activity	Arjunolic acid	Arsenic induced cytotoxicity in isolated murine hepatocytes	Cytoprotective activity of Arjunolic acid protects arsenic induced cytotoxicity in murine hepatocytes	[39]
Reproductive activity	Arjunolic acid, a triterpenoid saponin isolated from the bark	Arsenic induced testicular damage in mice	Chemopreventive role against toxicity	[40]
Wound healing activity	Hydroalcohol and tannins extract of the bark	Dermal wounded rat *in vivo*	Astringent of tannins by drawing the tissues closer together.	[12]

Side effects of *T. arjuna* Roxb.

T. arjuna Roxb. has been used in the dose of 1-2 g/day in various clinical studies. At this dosage, it is well tolerated and has fewer side effects like mild gastritis, headache and constipation. No haematological, metabolic, renal and hepatic toxicity has been reported even more than 24 months of its administration [24, 61]. *It* has role in contraindicated obesity. It tends to decrease the amount of fat by eliminating it from the body. For this reason, in the case of an obese person, the risk or benefit ratio of the cardiovascular benefits must be evaluated [57].

Tissue Culture of *T. arjuna* Roxb.

In vitro clonal propagation of this medicinal plant of *T. arjuna* Roxb. has been reported by using cotyledonary node explants from 21 day old seedlings which were cultured on MS medium supplemented with different concentrations of BAP for shooting and IBA for root generation. About 80% of these plantlets were successfully acclimatized and 70% plantlets were transferred in the field. [58].

CONCLUSION

The present comprehensive etheno- medicinal or etheno- pharmaceutical review reveals that *T. arjuna* Roxb. is a very important medicinal plant with its large number of phytochemical and pharmacological properties as well as medicinally important chemicals like tannins, triterpenoid, saponins, flavonoids, gallic acid, ellagic acid, oleanolic, arjunic acids. From the point of view a number of investigations of pharmacological activity have been observed. *T. arjuna* Roxb. is to be very useful in anti-bacterial, anti-viral, anti-mutagenic**,** anti-inflammatory and wound healing activities. While some of the other reported uses include anti-dysentric, anti-pyretic, anti-diabetic, anti-oxidant, gastric and reproductive activity. The most exciting aspects of the medicinal plant of *T. arjuna* Roxb. was treatment of diabetics, cancer and heart diseases. This compendium literature are supported various potential medicinal characteristics of *T. arjuna* Roxb. So, this review can be a preliminary authentic source for the researchers to investigate the unknown and unexplored potential of this medicinal plant of *T. arjuna* Roxb. through modern techniques such as NMR, Mass spectrophotometer analysis, HPLC and HPTLC. Moreover, further systematic study and research is essential to extend the next stage of clinical trial to form novel drugs for the treatment of serious ailments.

REFERENCES

1. Ali A, Kaur G, Hayat K, Ali M, Ather M; A novel naphthanolglycoside from *Terminalia arjuna* with antioxidant and nitric oxide inhibitory activities. *Pharmazie.*, 2003a; 58: 932-934.
2. Ali A, Kaur G, Hamid H, Abdulla T, Ali M, Niwa M, Alam MS; Terminoside A, a new trite pine glycoside from the bark of *Terminalia arjuna* inhibits nitric oxide production in murine macrophages. J Asian Nat Prod Res., 2003b; 5:137-142.
3. Anjaneyulu ASR, Prasad AVR; Chemical examination of roots of *Terminalia arjuna* (Roxb.) Wight & Arnot. Part I. Characterization of two new triterpenoid glycosides. Indian J Chem., 1982a; 21B:530-533.
4. Anjaneyulu ASR, Prasad AVR. Chemical examination of roots of *Terminalia arjuna*—the structure of arjunoside III and arjunoside

IV, two new triterpenoid glycosides. Phytochem 1982b; 21:2057-2060.
5. Anjaneyulu ASR, Prasad AVR; Structure of terminic acid, a dihydroxy triterpene carboxylic acid from *Terminalia arjuna*. Phytochem., 1983; 22:993-998.
6. Anonymous; *Terminalia arjuna*. Altern Med Rev., 1999; 4:436-437.
7. Bharani A, Ganguli A, Bhargava KD; Salutary effect of *Terminalia arjuna* in patients with severe refractory heart failure. Int J Cardiol, 1995;49:191-199.
8. Biswas KR, Ishika T, Rahman M, Swarna A, Khan T, Monalisa MN, et al; A Review of Scientific Literature on Anti-diabetic Activity in Medicinal Plants Used by Folk Medicinal Practitioners of Two Villages in Narail and Chuadanga Districts, Bangladesh for Treatment of Diabetes. Am-Eurasian J Sustain Agric., 2011; 5:196-208.
9. Biswas M, Biswas K, Karan TK, Bhattacharya S, Ghosh AK, Haldar PK; Evaluation of analgesic and anti-inflammatory activities of *Terminalia arjuna* leaf. J Phytol., 2011;3:33-38.
10. Caius JS, Mhaskar KS, Isaacs M; A comparative study of the dried barks of the commoner Indian species of genus *Terminalia*. Ind. Med. Res. Memoirs., 1930;16:51-75.
11. Chatterjee ASCP; The Treatise on Indian Medicinal Plants. Publication and Information Directorate. Council of Scientific and Industrial Research. New Delhi. Vol. III.1994.
12. Chaudhari M, Mengi S; Evaluation of phytoconstituents of *Terminalia arjuna* for wound healing activity in rats. Phytother Res., 2006; 20:799-805.
13. Chen CH, Liu TZ, Kuo TC, Lu FJ, Chen YC, Chang-Chien YW, et al; Casuarinin protects cultured MDCK cells from hydrogen peroxide-induced oxidative stress and Dna oxidative damage. Planta Med., 2004; 70:1022-1026.
14. Cheng HY, Lin CC, Lin TC; Antiherpes simplex virus type 2 activity of casuarinin from the bark of *Terminalia arjuna* Linn. Antivir Res., 2002;55:447-455.
15. Chopra RN, Chopra IC, Handa KL, Kapur LD; *Terminalia arjuna* W&A (Combretaceae). In: Chopra RN, Chopra IC, Handa KL, Kapur LD (Eds.), Chopra's Indigenous Drugs of India, 1st ed. UN Dhur & Sons, Calcutta, India; 1958, p. 421-424.
16. Chopra RN, Ghosh S; *Terminalia arjuna*: its chemistry, pharmacology and therapeutic action. Ind Med Gaz., 1929;64:70-73.
17. Choubey BK, Srivastava SK; Antifungal agents from *Terminalia arjuna*. Indian J Chem., 2001;40B:354-356.
18. Choudhari AB, Nazim S, Gomase PV, Khairnar AS, Shaikh A, Choudhari P; Phytopharmacological review of Arjuna bark. J Pharma Res., 2011;4:580-581.
19. Devi RS, Kist M, Vani G, Devi CS; Effect of methanolic extract of *Terminalia arjuna* against *Helicobacter pylori* 26695 lipopolysaccharide-induced gastric ulcer in rats. J Pharm Pharmacol., 2008;60:505-514.
20. Dwivedi S; *Terminalia arjuna* Wight & Arn. - A useful drug for cardiovascular disorders Preventive Cardiology Group. J Ethnopharmacol., 2007; 114:114-29.
21. Dwivedi S, Agarwal MP; Antianginal and cardioprotective effects of *Terminalia arjuna*, an indigenous drug in coronary artery disease. J Assoc Physicians India, 1994; 42:287-289.
22. Dwivedi S, Chansouria JPN, Somani PN, Udupa KN; Effect of *Terminalia arjuna* on ischaemic heart disease. Altern Med., 1989; 3:115-122.
23. Dwivedi S, Udupa N; *Terminalia arjuna*: Pharmacognosy, phytochemistry, pharmacology and clinical use a review. Fitoterapia, 1989;5:413-420.
24. Dymock WM, Warden GH, Hooper D; Pharmacographica India, Thodkar Spink Company, London; 1891.
25. FAO; Trade in Medicinal Plants, Economic and Social Department, Food and Agriculture Organization of the United Nations, Rome, Italy, 2004.
26. Ghani A; Medicinal Plants of Bangladesh. 2nd ed. 2003, p.1-2, 55-57, 402, 500.
27. Ghosh S; Annual report of the Calcutta School of Tropical Medicine. Institute of Hygiene and the Carmichel Hospital for Tropical Diseases, Calcutta, India; 1926.
28. Gill BS, Bir SS, Singhal VK; Cytogenetics of Some Timber Species of *Terminalia* Linn. (Combretaceae). Proc. Indian natn. Sci. Acad 1982, p. 779-790.
29. Halder S, Bharal N, Mediratta PK, Kaur I, Sharma KK; Anti-inflammatory, immunomodulatory and antinociceptive activity of *Terminalia arjuna* Roxb bark powder in mice and rats. Indian J Exp Biol., 2009;47:577-583.
30. Honda T, Murae T, Tsuyuki T, Takahashi T; The structure of arjungen: a new sapogenin from *Terminalia arjuna*. Chem Pharm Bull., 1976a; 24:178-180.
31. Honda T, Murae T, Tsuyuki T, Takahashi T, Sawai M; Arjungenin, arjunglucoside I and arjunglucoside II, a new triterpene and new triterpene glucosides from *Terminalia arjuna*. Bull Chem Soc Jap., 1976b;49:3213-3218.
32. Kaur K, Arora S, Kumar S, Nagpal A; Modulatory effect of phenolic fractions of *Terminalia arjuna* on the mutagenicity in Ames assay. J Environ Pathol Toxicol Oncol., 2002; 21:45-56.

33. Kaur S, Grover IS, Kumar S; Antimutagenic potential of extracts isolated from *Terminalia arjuna*. J Environ Pathol Toxicol Oncol., 2001; 20:9-14.
34. Kaur SJ, Grover IS, Kumar S. Modulatory effects of a tannin fraction isolated from *Terminalia arjuna* on the genotoxicity of mutagens in *Salmonella typhimurium.* Food Chem Toxicol., 2000; 38:1113-1119.
35. Kumar S, Enjamoori R, Jaiswal A, Ray R, Seth S, Maulik SK; Catecholamine-induced myocardial fibrosis and oxidative stress is attenuated by *Terminalia arjuna* (Roxb.). J Pharm Pharmacol., 2009; 61:1529-1536.
36. Kumar R, Verma RK; New host records of some Foliculaceous Fungi from india. Ind Phytopatholog., 1987; 40:274.
37. Li TC, Chien SC, Chen HF, Hsu FL; Tannins and related compounds from Combretaceae plants. Chin Pharma J., 2001; 52:1-26.
38. Manlik G, Maulik N, Bhandari V; Evaluation of antioxidant effectiveness of a few herbal plants. Free Radical Res., 1997; 27:221-228.
39. Manna P, Sinha M, Pal P, Sil PC; Arjunolic acid, a triterpenoid saponin, ameliorates arsenic-induced cyto-toxicity in hepatocytes. Chemico Biol Interact., 2007; 170:187-200.
40. Manna P, Sinha M, Sil PC; Protection of arsenic-induced testicular oxidative stress by arjunolic acid. Redox Rep., 2008; 13:67-77.
41. Miller AL; Botanical influences on cardiovascular disease. Altern Med Rev., 1998; 3:422-31.
42. Nagpal A, Meena LS, Kaur S; Growth suppression of human transformed cells by treatment with bark extracts from a medicinal plant, *Terminalia arjuna*. In Vitro Cell Dev Biol Anim., 2000; 36:544-547.
43. Orwa; *Terminalia arjuna* Combretaceae (Roxb. ex DC.) Wight & Arn. Agroforestry Database 4.0; 2009.
44. Paarakh PM; *Terminalia arjuna* (Roxb.) Wt. and Arn. : A review. Int J Pharmacol., 2010; 6:515-534.
45. Padmaa MP, Leena JP, Angelin ST; Genius *Salacia*: A comprehensive review. J Nat Remedies, 2008; 8:116-131.
46. Padmaa MP; Phytoconstituents from the genus *Petunia*: A review. Pharmacol online Newsletter, 2009d; 1:195-208.
47. Padmaa MP; *Terminalia arjuna (Roxb.) Wt. and Arn.: A review, Int J Pharmacol., 2010;6(5):515-534.*
48. Pandey S, Jaiswal VS; Micropropagation of *Terminalia arjuna* Roxb. from cotyledonary nodes. Ind J Exp Biol., 2002;40:950-3.
49. Pasquini R, Scassellati-Sforzolini G, Villarini M; In vitro protective effects of *Terminalia arjuna* bark extracts against the 4-nitroquinoline-N-oxide genotoxicity. J Environ Pathol Toxicol Oncol., 2002; 21:33-44.
50. Pettit GR, Hoard MS, Doubek DL, Schmidt JM, Pettit RK, Tackett LP, et al; Antineoplastic agents 338. The cancer cell growth inhibitory constituents of *Terminalia arjuna* (Combretaceae). J Ethnopharmacol., 1996;53:57-63.
51. Raghavan B, Kumari SK; Effect of *Terminalia arjuna* stem bark on antioxidant status in liver and kidney of alloxan diabetic rats. Indian J Physiol Pharmacol., 2006; 50:133-142.
52. Ray PG, Majumdar SK; Antimicrobial activity of some medicinal plants. Econ Bot., 1976; 30:317-320.
53. Row LR, Murty PS, Subbarao GSR, et al; Chemical examination of *Terminalia* species. Part XII. Isolation and structure determination of arjunic acid, a new trihydroxytriterpene carboxylic acid from the bark of *Terminalia arjuna*. Ind J Chem., 1970a; 8:716-721.
54. Row LR, Murty PS, Subbarao GSR, et al; Chemical examination of *Terminalia* species. Part XIII. Isolation and structure determination of arjunetin from *Terminalia arjuna*. Ind J Chem., 1970b; 8:772-775.
55. Salim KP, Padmaa MP; A phyto-pharmacological review of *Syzygium cumini* skeels. Pharmacol online Newsletter, 2009;2:110-122.
56. Sandeep, Padmaa MP; *Jasminum grandiflorum* Linn (Chameli): Ethnobotany, phytochemistry and pharmacology: A review. Pharmacol online Newsletter, 2009; 2:586-595.
57. Sharkar P, Rahman MM, Masum GZH, Nayeem MA, Hossen MM, Azad AK; Ethnomedicinal Importance of the Plants of different Villages in Kushtia Sador and Mirpur Upozila, Bangladesh. J Herbs Spices Med Plants, 2013; 19:401–417.
58. Sarker S, Seraj S, Sattar MM, Haq WM, Chowdhury MH, Ahmad I, et al.; Medicinal Plants Used by Folk Medicinal Practitioners of Six Villages in Thakurgaon District, Bangladesh. Am-Eurasian J Sustain Agric., 2011 ; 5:332-343.
59. Saxena M, Faridi U, Mishra R, Gupta MM, Darokar MP; Cytotoxic agents from *Terminalia arjuna*. Planta Med., 2007; 73:1486-1490.
60. Shah CS, Bhavsar GC; Pharmacognosy of the bark of *Terminalia tomentosa* W& A and comparison with *Terminalia arjuna* W& A bark. Ind J Pharmacol., 1956;18:81-84.
61. Shailaa HP, Udupa SL, Udupa AL; Hypolipidemic activity of three indigenous drugs in experimentally induced atherosclerosis. Int J Cardiol., 1998; 67:119-124.

62. Sharma PN, Shoeb PN, Kapil RS, Popli SP; Arjunolone- a new flavone from stem bark of *Terminalia arjuna*. Indian J Chem., 1982; 21B:263-264.
63. Shinde SL, Junne SB, Wadje SS, Baig MMV; The diversity of antibacterial compounds of *Terminalia* species (Combretaceae). Pak J Biol Sci., 2009; 12:1483-1486.
64. Takahashi S, Tanaka H, Hano Y, Ito K, Nomura T, Shigenobu K; Hypotensive effects in rats of hydrophyllic extract from *Terminalia arjuna* containing tannin-related compounds. Phytother Res., 1997; 1:424-427.
65. Verma N, Vinayak M; Effect of *Terminalia arjuna* on antioxidant defence system in cancer. Mol Biol Rep., 2009; 36:159-164.