



International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

BIOLOGICAL ACTIVITY OF AVERRHOA BILIMBI

AkshayC*, D.Visagaperumal and Vineeth Chandy

Department of Pharmaceutical Chemistry, T. John College of Pharmacy

Bangalore, Karnataka

ABSTRACT:

Averrhoa bilimbi Linn. is essentially developed for therapeutic purposes in numerous tropical and subtropical nations of the world. The aim of this study was to give a collective information of this herb as hypotensive, antioxidant, anti-diabetic, hypolipidemic agent and as an anti-cancer agent. The main purpose of this review is to collect and organise the literature based on traditional claims and compare it with current data on the use of *Averrhoa bilimbi* for the treatment of various diseases.

KEYWORDS:

Averrhoa bilimbi, Antidiabetic, Antioxidant, Antihyperlipidaemic

CORRESPONDING AUTHOR

Akshay C

Department of Pharmaceutical Chemistry

T. John College of Pharmacy

Bangalore, Karnataka 560083, India

Email: akshaybkn88@gmail.com

Mob no: 7025784594

INTRODUCTION:

Averrhoa bilimbi (bilimbi) is used as a traditional remedy for many symptoms. It is used as an antibacterial, anti-inflammatory, astringent. Postpartum pills. It is also used for treatment of fever, mumps, acne, rectal inflammation and diabetes, itching, ulcers, rheumatism, syphilis, biliary colic, whooping cough, high blood pressure, indigestion, aphthous ulcers, and as a cooling drink.

The fruit of *Averrhoa bilimbi* has medicinal properties to effectively treat a number of human diseases. Different parts of the plant are used in different conditions. The fruits are used as a remedy for cough. The syrup from this fruit is used not only to treat fever and inflammation but also to stop rectal bleeding and relieve internal haemorrhoids. Malaysians use fresh or fermented leaves to treat sexually transmitted diseases. The infusion is a cough suppressant and is taken as a tonic after childbirth. A decoction of the leaves helps relieve inflammation of the rectum. The infusion of flowers is believed to be effective for coughs and mouth ulcers. In Java, the fruits combined with pepper are eaten to cause sweating when people are feeling "under the weather". Rubbing the pickled bilimbi paste all over your body will speed up your recovery from fever. Very acidic fruits are employed to clean the blade of a kris (dagger), and they serve as mordants in the preparation of an orange dye for silk fabrics. Because of its oxalic acid content, fruit juice is useful for bleaching stains from the hands and rust from white cloth, and also tarnishes from brass.¹⁻⁷

SCIENTIFIC CLASSIFICATION ⁸

Kingdom:	Plantae
Family	Oxalidaceae
Genus:	<i>Averrhoa</i>
Species	<i>bilimbi</i>
Binomial NAME	<i>Averrhoa bilimbi</i>

Table 1

COMMON NAMES:

- English: Bilimbi, Cucumber tree, tree sorrel
- Spanish: Bilimbi, Limon chino, Mimbrolargo
- French: Carambolier bilimbi
- Chinese: San lian
- Other names
- *Averrhoa obtusangula* stokes, Belimbingasam, Belimbingbuluh, Belimbingwuluh, Kamias, kalamias, Iba, kolonanas, Ta-ling-pring.⁹

DESCRIPTION:

The tree is attractive, has a long-life span and can reach 5-10 m in height. It has short stems, which immediately split into several erect branches. Very similar to the othakhith gooseberry, the leaves that accumulate mainly at the ends of the branches are alternating incompatible, 30 to 60 cm long, 11 to 37 alternating or incompatible leaves (figure no:4), ovoid or oval, with a rounded bottom and pointed ends. soft; Medium green at the top, pale at the bottom; 2-10 cm long, 1.2-25 cm wide. Small fragrant flowers (figure no:1) with five petals, yellow-green or purple and dark purple, come from the thickest stems and the oldest twigs, a few twigs, small hairy buds protruding directly from strange clusters of fruits(figure no:2 and 3). When ripe, crispy fruits change colour from light green to yellow-green, ivory or nearly white when ripe, and fall to the ground. The skin is shiny, very thin, soft, the flesh is green, gelatinous, juicy and very sour. Bilimbi begins to bloom around February and continues to bloom and bear fruit until December.



Figure no:1 Flower



Figure no:2Fruit



Figure no:3 Fruit



Figure no:4 Leaves

DISTRIBUTION:

Bilimbi probably originated from Maluku and grew up throughout Indonesia. It has been cultivated and raised wild throughout the Philippines. Distributed in Ceylon and Burma. It is very common in Thailand, Malaya and Singapore. Often in the gardens of the Indian Plains. It was introduced in Queensland around 1896 and could be easily integrated and distributed into production networks ductive.³

ETHNOMEDICINAL USES

Averrhoa bilimbi is used in traditional medicine for treatment of various diseases. The infusion and decoction of the leaves are used as antibacterial, antiscorbutic, astringent, postpartum protectant in the treatment of fever, inflammation of the rectum and diabetes. Paste of leaves are used to treat itching, boils, rashes, poisonous bites, rheumatism, coughs, colds, mumps, and syphilis. Grated fruit with a little salt is added applied to the face to treat acne. The fruit juice is used to treat scurvy, biliary colic, whooping cough, high blood pressure, obesity, and diabetes.¹⁰⁻¹⁴

PHYTOCHEMICAL CONSTITUENTS:

Fruit's:

Analysis of the Malaysian *A. bilimbi* fruit revealed 53 different ingredients as volatile. The main ingredients are palmitic acid (20.4%) 2-furaldehyde (19.1%), and (Z)-9-octadecenoic acid (10.2%)

The 12 identified compounds were esters, of which butyl nicotinate and hexyl nicotinate were present in large quantities.

Fruit extracts contain flavonoids, saponins and triterpenoids. It also contains Amino acids, Citric acids, Cyanidin-3-O-h-D-glucoside Phenolics, Potassium ion, Sugars, Vitamins.

Leaves:

Phytochemical screening of leaf extracts showed the presence of alkaloids, tannins, saponins, flavonoids, cardiac glycosides, glycosides, triterpenes, phenols, and carbohydrates.¹⁶

Gunawan *et al.*, investigated the isolation of seven constituent from the leaves extract of *A. bilimbi*. These include squalene, 3-(6,10,14-trimethylpentadecan-2-yl) furan-2 (5H)-one, 2,3-bis(2,6,10-trimethylundeca-1,5,9-trienyl) oxirane, phytol, 3,4-Dihydroxyhexanedioic acid, malonic acid, and 4,5-Dihydroxy-2-methylenehydroxybenzaldehyde¹⁷

Nutrition value:¹⁵

Rich in vitamin C. In addition to vitamins and minerals, fruits contain fiber, ash, protein, moisture and minerals.

Vitamin per 100mg:

Riboflavin(Vitamin B2)	0.026 mg
Vitamin B1(thiamine)	0.010 mg
Niacin	0.302 mg
Ascorbic Acid	15.6 mg
Carotene	0.035 mg
Vitamin A	0.036 mg

Table 2: Vitamin composition of bilimbi fruit

Minerals per 100 g

Phosphorus	11.1 mg
Calcium	3.4 mg
Iron	1 mg

Table 3: Mineral composition of bilimbi fruit

Antioxidant activity:

Antioxidants are compounds that protect cells from damage by interacting with free radicals and neutralizing them. In recent years, much attention has been paid to the therapeutic potential of antioxidants in diseases associated with oxidative stress. The result obtained revealed that *A. bilimbi* leaves extracts (0.02% w/v) displayed moderate antioxidant activity in ferric thiocyanate and thiobarbituric acid methods while it was found to be inactive in 2,2-Diphenyl-1-(2,4,6-trinitrophenyl)hydrazyl (DPPH) assay.¹⁹⁻²¹

Abas *et al.*, Investigated the antioxidant characteristics and the impact on nitric oxide generation in lipopolysacchride -activated macrophages of *A. bilimbi* and 11 different customary vegetables. The finding uncovered that *A. bilimbi* leave extracts (0.02% w/v) showed moderate antioxidant action in ferric thiocyanate and thiobarbituric acid techniques while it was discovered to be inactive in 2,2-diphenyl-1-(2,4,6-trinitrophenyl) hydrazyl (DPPH) assay.¹⁸

Antidiabetic activity:

DM affects hundreds of millions of people around the world. Diabetes mellitus is a complex metabolic disorder caused by insulin deficiency or dysfunction of insulin. It is a serious public health problem that affects over 400 million people worldwide.

Benny *et al.*, have studied the hypoglycaemic and hypolipidemic activity of semi purified fractions of ethanol extract of *Averrhoa bilimbi* leaves in high fat diet (HFD)-streptozotocin (STZ)-induced diabetic rats. Prolonged administration of the aqueous fraction (HF) at a dose of 125 mg / kg significantly reduces the concentration of glucose in the blood and triglycerides compared to carriers. The glycogen content in the liver was quite high AF-treated mice compared to controls. They have suggested AF as a potential source for the isolation of oral antidiabetic drugs. Another study by Pushparajet *al.*, investigated the possible mechanisms of the hypoglycaemic action of hexane, ethyl

acetate, butanol, and aqueous fractions of the ethanol extract of *A. bilimbi* leaves in male Sprague-Dawley rats with STZ-diabetes. The hypoglycaemic properties of various fractions were evaluated in mice with STZ-diabetes at a dose of 125 mg/kg body weight. The results showed that administration of an oral aqueous fraction to rats with STZ-induced diabetes significantly increased insulin secretion and glucose tolerance, while simultaneously decreasing the activity of glucose-6-phosphatase in the liver. The resulting increase in serum insulin is believed that the possible mechanism of action plant.²²⁻²⁴

Antihyperlipidemic activity:

Ambiliet *al.*, has investigated antihyperlipidemic activity of the fruit *Averrhoa bilimbi* in rats using a model of Triton induced hypercholesterolemia. The fruit and its aqueous extracts exhibit remarkable anti hypercholesterolemic activity. The active fraction exhibiting activity at a low dose of 0.8 mg/kg was purified from the aqueous extract. The active ingredient is separated from the active fraction and exhibits optimal activity at a dose of 0.3 mg/kg. The fruit's efficacy was tested on a chronic high-fat diet fed to hyperlipidaemic rats. Fruit (125 mg/kg) and aqueous extract (50 mg/kg) have been shown to be effective in reducing body fat in high-fat rats. They concluded that this fruit can be used as a food ingredient to prevent and treat hyperlipidaemia. Pusparajet *al.*, also examined the lipid profile in rats with streptozotocin-induced diabetes and found it to be effective. Ethanol extract of bilimbi fruit significantly increased the antiatherogenic index and the ratio of HDL cholesterol to total cholesterol. It also significantly reduces the rate of lipid peroxidation in the kidney. Their study demonstrated hypotriglyceridaemia, lipid peroxidation, and anti-atherogenic activity in STZ diabetic rats.²⁷

Antihypertensive activity:

High blood pressure is considered a major risk factor for various cardiovascular diseases such as arteries, heart failure, stroke, coronary artery disease, and kidney failure. In recent years, much attention has been paid to the use of herbal preparations as an alternative to the treatment and prevention of cardiovascular complications. Traditionally, *A. bilimbi* berries and leaves have been effectively used as a symptom of blood pressure. Bipatet *al.* used an isolated in vitro organ model to scientifically investigate the ability of aqueous extracts of *A. bilimbi* and other plant leaves to lower blood pressure. The aqueous extracts of the leaves were found to significantly reduce norepinephrine-stimulated atrial contractility without affecting the heart rate of guinea pigs. The leaf extract has also shown significant antihypertensive effects in in vivo experiments in cats, indicating that the leaf extract may be a potential hypertensive drug.²⁸⁻³¹

Antimicrobial activity:

The development of widespread antibiotic resistance in recent years has created a new demand for new antimicrobial agents for the treatment of infectious diseases. *A. Bilimbi* ethanol extract has significant antimicrobial activity against 6 pathogens against 2 gram-positive bacteria (*Bacillus cereus* and *Bacillus megaterium*), 2 gram-negative bacteria (*Escherichia coli* and *Pseudomonas aeruginosa*) and 2 fungi (*Cryptococcus Neoformansa* and *Aspergillus ochraceous*) Whole borrowed non-fruit juices and blended dull without juice at 1: 2and 1:4 w/v concentrations, It shows significant activity against *Listeria monocytogenes* Scott A and *Salmonella typhimurium* in an in vitro antimicrobial test. The extracts of fruitwasalso found to reduce the microbial load of *L. monocytogenes* Scott A and *S. typhimurium* on raw shrimp after washing and storage. This shows the possibility that *A. bilimbi* will be recognized as a natural method for decontaminating shrimp immediately prior to consumption. Another study showed that *A. bilimbi* fruit and root extract showed positive activity against *Mycobacterium tuberculosis* with a MIC of 1600 µg / ml.³²⁻³⁴

Antifertility:

Studies in mice have shown that bilimbi is a potential source of fertility drugs. It has been shown that the butanol fraction of the ethanol extract reduces fertility. This activity can be caused by one or both of the steroidal glucoside and potassium oxalate components.³⁵

Wound healing:

Several medicinal plants have been shown to have important healing properties. In this context, the use of *Averrhoa bilimbi* for the treatment of oral injuries has also been scientifically studied. Iga conducted ainvestigation the effect of *A. bilimbi* leaf extract on wound healing.³⁶

Anticancer activity:

Cytotoxicity tests are used to find whether a molecule or extract is toxic to cells. Cytotoxicity tests are routinely used in screening for anti-tumor drugs. When analyzing shrimp mortality, it was found that the ethanol extract of *A. bilimbi* leaves had moderate cytotoxic activity(LC50, 5.81 µg/l). In another study, methanol fruit extract and its fractions CCl₄ and petroleum ether showed significant cytotoxic potential. (LC50 of 0.005 µg/ml, 1.198 µg/ml and 0.781 µg/ml, respectively,) compared to vincristine sulfate (with LC50 of 0.839 µg/ml). In another similar study, LC50 values of chloroform and water-soluble fraction were found 5,691 and 6,123 µg / ml, respectively.^{37,38}

Thrombolytic activity:

Anticoagulant herbs are used as antithrombotic. Anticoagulant herbs are effectively used for angina, hepatitis, coronary artery disease, dysmenorrhea, rheumatoid arthritis, traumatic injuries, tumors, depression, kidney failure, stroke prevention, and post-stroke syndrome. The anticoagulant effect of *A. bilimbi* has been demonstrated by Daud *et al.* in normal and alloxan-induced diabetic rats. In their experiment, they found that oral administration of ethanol extract from leaves and fruits (250 mg / kg) for 14 days produced a significant anticoagulant effect, as observed with an increase in prothrombin time. In another similar study, crude methanolic extract and separate leaf fraction showed significant thrombolytic activity (17.06-27.72%) in *in vitro* assay.^{39,40}

Toxicity:

Averrhoa bilimbi fruit contains excessive quantity of oxalic acid. Excessive consumption of fruit juices can lead to increased serum oxalate levels and a buildup of calcium oxalate crystals in the kidney tubules, which can lead to acute kidney failure.

Savithriet *al.*, has investigated the preliminary general toxicity of *A. bilimbi* fruit. Daily oral ingestion homogenate fruits for 15 days did not cause signs of toxicity up to a dose of 1 g/kg.

Bakulet *al.*, investigated a series of cases from five hospitals in Kerala state who developed acute kidney failure after drinking fruit juice (100–400 ml/day). All patients had severe renal insufficiency with serum creatinine ranging from 5.5-12.3 mg / dL, and renal biopsy showed acute tubular necrosis with calcium oxalate crystals. Seven out of ten patients required hemodialysis, but fortunately they all recovered after 2-6 weeks of treatment.³² Nair et al. also reported two cases of acute nephropathy with tubular oxalate deposition after consumption of fruit juices.^{41,42}

Conclusion:

Plants are the main source of biologically active compounds for various types of biological activity in humans and animals. Since obesity and diabetes are widespread in our society, research is being done on plants with antidiabetic and antibacterial properties, as recent studies of various plant parts have shown. In order to achieve the optimal effect for the patient, it is necessary to isolate, purify the appropriate components and conduct further clinical studies.

Reference:

1. Pulok K Mukherjee, KuntalMaiti, Kakali Mukherjee, peter J Houghton. Leads from Indian medicinal plants with hypoglycemic potentials. *Journal of Ethno-Pharmacology*. 2006;106(2006):1-28.
2. Snehal S Patel, Rajendra S Shah, Ramesh K Goyal. Antihyperglycemic, antihyperlipidemic and antioxidant effects of Dihar, a polyherbal ayurvedic formulation in streptozotocin induced diabetic rats. *Indian J Exp Biol*. 2009;47(1):564-570.
3. A Saravana Kumar, S Kavimani, K N Jayaveera. A Review on Medicinal Plants with Potential Antidiabetic Activity. *IJP*. 2011; 2(2):53-60.
4. Sharma A, Chandraker S, Patel VK, Ramteke P. Antibacterial activity of medicinal plants against pathogens causing complicated urinary tract infections. *Indian journal of pharmaceutical sciences*. 2009 Mar;71(2):136.
5. Almarshad FM. Evaluation of fibrinolytic efficacy of *Averrhoa Bilimbi* linn. by using euglobulin lysis time method. *International Journal of Medical Research & Health Sciences*. 2019;8(9):21-4.
6. Wahab NH, Abd Wahid ME, Taib MB, Zain WZ, Anwar SA. PHCOG J: Research Article Phytochemical screening and antimicrobial efficacy of extracts from *Averrhoa bilimbi* (Oxalidaceae) fruits against human pathogenic bacteria.
7. Sharma A, Shanker C, Tyagi LK, Singh M, Rao CV. Herbal medicine for market potential in India: an overview. *Acad J Plant Sci*. 2008;1(2):26-36.
8. Anitha Roy, Geetha RV, Lakshmi. *Averrhoa bilimbi* Linn-nature's Drug Store- A Pharmacological Review. 2010;3(3):101-106.
9. K Ashok Kumar, SK Gousia, Anupama M, J Naveena Lavanya Latha. A review on phytochemical constituents and biological assays of *Averrhoa bilimbi*. *International Journal of Pharmacy and Pharmaceutical Science Research* 2013; 3(4): 136-139.
10. Ganders FR. The biology of heterostyly. *New Zealand Journal of Botany*. 1979 Dec 1;17(4):607-35.
11. Goh SH, Chuah CH, Mok JS, Soepadmo E. *Malaysian Medicinal Plants for the Treatment of Cardiovascular Diseases*, Pelanduk Publication Sdn. Bhd., Selangor, Malaysia. 1995:95-6.
12. Samuel AJ, Kalusalingam A, Chellappan DK, Gopinath R, Radhamani S, Husain A, Muruganandham V, Promwichit P. Ethnomedical survey of plants used by the orang asli in Kampung Bawong, perak, West Malaysia. *Journal of ethnobiology and ethnomedicine*. 2010 Dec;6(1):1-6.

13. Ong HC, Nordiana M. Malay ethno-medico botany in Machang, Kelantan, Malaysia. *Fitoterapia*. 1999 Oct 1;70(5):502-13.
14. Alsarhan A, Sultana N, Kadir MR, Aburjai T. Ethnopharmacological survey of medicinal plants in Malaysia, the Kangkar Pulai region. *International Journal of Pharmacology*. 2012;8(8):679-86.
15. Julia F. Morton. *Fruits of warm climates*. 1987;1:128-129.
16. Alhassan Muhammad Alhassan, Qamar Uddin Ahmed. *Averrhoa bilimbi* Linn. A review of its ethnomedicinal uses, phytochemistry and pharmacology. *Journal of pharmacy and Bioallied Sciences*. 2016;8(4):265-271.
17. Gunawan CA, Paano A. Structure elucidation of two new phytol derivatives, a new phenolic compound and other metabolites of *Averrhoa bilimbi*. InDLSU Res. Congress 2013 Mar 7 (pp. 1-8).
18. Faridah Abas, Nordin H Lajis, D A Israf, S Khozirah, Y Umi Kalsom. Antioxidant and nitric oxide inhibition activities of selected Malay traditional vegetables. *Food chemistry*. 2006;95(2006):566-573.
19. A Noor Asna, A Noriham. Anti-oxidant Activity and Bioactive Components Of Oxalidaceae Fruit Extracts. *The Malaysian Journal of Analytical Sciences*. 2014;18(1):116-126.
20. Sabiha Sultana Chowdhury, Golam Mezbah Uddin, NaziaMumtahana, Mokarram Hossain, S.M. Raquibul Hasan. in-vitro antioxidant and cytotoxic potential of hydromethanolic extract of *averrhoa bilimbi*. fruits. *IJPSR*. 2012;3(7):2263-2268.
21. Dewan SM, Amin MN, Adnan T, Uddin SN, Shahid-Ud-Daula AF, Sarwar G, Hossain MS. Investigation of analgesic potential and in vitro antioxidant activity of two plants of Asteraceae family growing in Bangladesh. *Journal of pharmacy research*. 2013 Jun 1;6(6):599-603.
22. Benny KwongHuat Tan, Chee Hong Tan, Peter Natesan Pushparaj. Anti diabetic activity of the semi-purified fractions of *Averrhoa bilimbi* in high fat diet fed-streptozotocin-induced diabetic rats. *Life Sciences*. 2005;76(2005):2827-2839.
23. P Pushparaj, C H Tan, B K H Tan. Effects of *Averrhoa bilimbi* leaf extract on blood glucose and lipids in streptozotocin-diabetic rats. *Journal of Ethnopharmacology*. 2000;72 (2000):69-76.
24. Pushparaj PN, Tan BK, Tan CH. The mechanism of hypoglycemic action of the semi-purified fractions of *Averrhoa bilimbi* in streptozotocin-diabetic rats. *Life Sciences*. 2001 Dec 21;70(5):535-47.
25. Pan S. *Natural products and insulin signalling* (Doctoral dissertation, uniwiien).

26. Ali H, Houghton PJ, Soumyanath A. α -Amylase inhibitory activity of some Malaysian plants used to treat diabetes; with particular reference to *Phyllanthus amarus*. *Journal of ethnopharmacology*. 2006 Oct 11;107(3):449-55.
27. SavithriAmbili, Appian Subramoniam, Natesan Shanmugam Nagarajan. Studies on the Antihyperlipidemic Properties of *Averrhoa bilimbi* Fruit in Rats. *Planta Med*.2009;75(2009):55-58.
28. AkibJaved Miraj, Asma Kabir, Yasir Mamun, Shammi Akhter, *et.al.*, Evaluation of the analgesic and anti-inflammatory activities of methanolic extracts of the leaves of *Averrhoa bilimbi* leaves. *Discovery Phytomedicine*. 2019;6(1):12-15.
29. RobbertBipat, Jerry R Toelsie, Rouafsa F Joemmanbaks, *et.al.*, Effects of plants popularly used against hypertension on norepinephrine-stimulated guinea pig atria. *Phcog Mag*. 2008;4(13):12-19.
30. Winarti C, Marwati T. Effect of bilimbi leaf extracts on decrease blood pressure. *J Pascapanen*. 2009;6:54–61
31. Baul S, Amin MN, Hussain MS, Mukul ME, Millat MS, Rashed MS. Phytochemical Nature and Pharmacological Evaluation of Chloroform Extract of *Pandanus fascicularis* L. Fruits): An in vivo Study. *J Bioanal Biomed*. 2017;9(4):223.
32. M MMackeen, AM Ali, SH El-Sharkawy, MY Manap, KM Salleh, NH Lajis K Kawazu. Antimicrobial and Cytotoxic Properties of Some Malaysian Traditional Vegetables (Ulam). *International Journal of Pharmacognosy*. 1997;35(3):174-178.
33. Zakaria ZA, Zaiton H, Henie EF, Jais AM, Zainuddin EN. In vitro antibacterial activity of *Averrhoa bilimbi* L. leaves and fruits extracts. *International Journal of Tropical Medicine*. 2007;2(3):96-100.
34. Mokhtar SI, Aziz NA. Antimicrobial Properties of *Averrhoa bilimbi* Extracts at Different Maturity Stages. *J Med Microb Diagn*. 2016;5(233):2161-0703.
35. Alipin K, Rochman IA, Malini DM, Madihah M. Reversibility Time in Testicular Damage on Male Wistar Rat after Treatment of *Averrhoa bilimbi* L. Fruits Extract as Antifertility. *Indonesian Journal of Pharmaceutical Science and Technology*. 2018 Jun 28;1(1):43-8.
36. IGAA HartiniIga H. Iga H. Topical application of ethanol extract of starfruit leaves (*Averrhoa bilimbi* Linn.) increases fibroblasts in gingival wounds healing of white male rats. *Indonesia journal of biomedical sciences*.2012;6(1):35-39.

37. Karon B, Ibrahim M, Mahmood A, Huq MA, Chowdhury MM, Hossain A, Rashid MA. Preliminary antimicrobial, cytotoxic and chemical investigations of *Averrhoa bilimbi* Linn. and *Zizyphus mauritiana* Lam. *Bangladesh Pharm J.* 2011;14(2):127-31.
38. Ali MR, Hossain M, Runa JF, Hasanuzzaman M. Preliminary cytotoxic activity of different extracts of *Averrhoa bilimbi* (fruits). *International Current Pharmaceutical Journal.* 2013 Feb 4;2(3):83-4.
39. Daud N, Hashim H, Samsulrizal N. Anticoagulant activity of *Averrhoa bilimbi* Linn in normal and alloxan-induced diabetic rats. In *The Open Conference Proceedings Journal* 2013 Dec 27 (Vol. 4, No. 1).
40. Ramjan A, Hossain M, Runa JF, Md H, Mahmudul I. Evaluation of thrombolytic potential of three medicinal plants available in Bangladesh, as a potent source of thrombolytic compounds. *Avicenna journal of phytomedicine.* 2014 Nov;4(6):430.
41. Bakul G, Unni VN, Seethaleksmy NV, Mathew A, Rajesh R, Kurien G, Rajesh J, Jayaraj PM, Kishore DS, Jose PP. Acute oxalate nephropathy due to 'Averrhoa bilimbi' fruit juice ingestion. *Indian journal of nephrology.* 2013 Jul;23(4):297.
42. Nair S, George J, Kumar S, Gracious N. Acute oxalate nephropathy following ingestion of *Averrhoa bilimbi* juice. *Case reports in nephrology.* 2014 Jan 1;2014.