"Unlocking the Therapeutic Triad: Antioxidant, Antidiabetic, and Antibacterial Proficiency of Syzygium cumini Chewable Tablets and Phytochemical Extracts – A Comprehensive Review"

[1] Mr. Shivshankar M. Nagrik, [2] Mr. Vikin P. Nagrik, [3]Himanshi A. Dhande, [4]Pratiksha S.Mapari .

[1] Student M.Pharm First Year, Rajarshi Shahu College of Pharmacy Buldana ,Maharashtra , India-443001.

[2,3,4] Student B.Pharm Final Year,Gawande College of Pharmacy, Sakharkherda , Buldhana, Maharashtra , India-443202.

Abstract

Syzygium is an important tropical fruit. The fruit is commonly known as jamun (Hindi), Java plum, black plum, jambul and Indian blackberry. It is a large forest tree found in India, Sri Lanka, Malaysia and Australia and is also grown for its fruit. The tree was introduced to Southern Africa from India and tropical Asia because of its good and attractive fruit. S. Fennel tree has been proven to have antiinflammatory and therapeutic properties; The extract contains compounds such as flavonoids, alkaloids, glycosides, steroids, phenols, saponins, terpenes, cardiac glycosides and tannins. Class of drugs contained in the extract. The aim of this study is to investigate the preliminary phytochemical analysis of Plane seeds belonging to the Myrtaceae family. Jamun is a popular fruit in India. It plays an important role in Ayurvedic medicine. I think this is good news for diabetics. But the organization of orchards is still not available in India, the main reason for this is the lack of sufficient knowledge about the cultivation method and the lack of dwarf variety and good value. Terpenes are known for their antibacterial, anti-inflammatory and anticancer properties, and triterpenes and terpenoids have been isolated. Saponins have been reported to have antibacterial, antifungal, antiviral, antiinflammatory and hemolytic, hepatoprotective and antiinflammatory properties. Current research results can be used in the development of herbal medicines and nanoparticles for disease prevention, anti-diabetic drugs, and many studies related to disease prevention to improve personal defense. Diabetes is increasing at an alarming rate worldwide due to lifestyle changes and has become a global burden requiring attention in countries with high population density, the situation has escalated. There are two types of type I diabetes, an autoimmune disease in which T lymphocytes play a role in the destruction of pancreatic beta cells and have a genetic predisposition. Type I diabetes is more common in children and adolescents.

Index Terms - Syzygium cumini, Medicinal uses, Myrtaceae, Phytochemistry, Traditional uses, Jambolan, Common plum, Java plum, Eugenia jambolana commonly known as jambolan, black plum, jamun, java plum, Indian blackberry, Portuguese plum, Malabar plum, purple plum, Jamaica and damsonplum .

I. Introduction

The use of medicinal plants shows potential as antibiotics and is often used as phytochemical extract from medicinal plants. Plants have different geographical distributions around the world, and people have used many parts of plants for food and medicine since the beginning of civilization. Many powerful herbs that help kill many diseases and strengthen the immune system are frequently grown and used in many parts of the world. The active metabolites found in many drugs are other metabolites; Substances such as alkaloids, flavonoids, saponins, tannins and steroids found in plants have the ability to fight many pathogenic bacteria and can improve the immunity of humans and other animals. [1]. Syzygium cumini Skeels (Synonym: Eugenia jambolana Lam.) 'Brahaspati' green (young), gray (mature), slightly smooth, glabrous Sanskrit, commonly as Java plum, Portuguese plum, Malabar plum, black plum, Indian blackberry, Jamun is known. Jambu, Jambul, Jambool and Naval belong to the Myrtaceae family [2]. S. cumini is a large evergreen tree native to India. However, it is also found in the tropical regions of East Africa, South America, Madagascar and the United States. [3,4] S. cumini is a medicinal plant and its products have been pharmacologically proven to have hypoglycemic effects. , antibacterial and anti-HIV activity [5-8].

Various parts of the plant such as bark, leaves, fruit and seeds are used in various medicines. [9] The leaves are used to treat leukorrhea, stomach ache, fever, skin diseases, [2] constipation, prevent fecal bleeding, [10] and reduce radiation due to DNA. [11] In addition to other medicinal treatments in India, the fruits of S. cumini are also used in Siddha, Ayurveda, Unani as a stomachic medicine, [12] astringent, antiscorbutic, diuretic, antidiabetic, splenomegaly, [13,14] and diarrhea. It is also used [15] Jamun fruit is a very useful food in the treatment of hemorrhoids and liver diseases. [16,17].

II. BOTANICAL DESCRIPTION

Kingdom: Plants

Family: Angiosperms

Subfamily: Eudicots

Order: Myrtales

Family: Myrtaceae

Genus: Syzygium

Species :cumini

Sr. No	Class of metabolite	Compounds identified
1	Flavonoids	Quercetin, rutin, 3,5,7,4-tetrahydroxy flavanone
2	Phenolic acids	Quercetin, rutin, 3,5,7,4-tetrahydroxy flavanone
3	Tannins	HHDP-galloyl glucose, trigalloyl glucose
4	Terpenes	Citronellol, geraniol, hotrienol, nerol, β-phenylethanol, phenylpropanal
5	Anthocyanins	Cyanidin, delfinidin, petudinin

Table 1: Phytochemical constituents found in cumin clove seed powder

III. MATERIALS & METHODS

Materials

Seeds of domestically grown Syzygium plants were collected, shade dried, powdered and sieved. This plant is certified by the Botanical Survey of India (BSI), located in the heart of Hyderabad, India. Stevia powder was purchased from Herbs N Spices, Neemuch, Madhya Pradesh, India. Lactose, gum arabic, glucose, talc, magnesium stearate, hydroxypropyl methylcellulose (HPMC), sodium alginate, guar gum, polyethylene glycol (PEG) 400, methylene chloride and ethanol. S.D Fine Chem Ltd. by Mumbai, Maharashtra, India.

Methods

Phytochemical analysis: According to previous reports [18], the seed powder was tested for alkaloids, cardiac glycosides, flavonoids, steroids/triterpenoids, tannins, phenols and saponins. Medical examination.[18]

Chewable Tablet Formula Plane Seed Powder Tablets: Tablets are produced by direct compression method [19-21]. Seven formulations were made with a fixed amount of seed powder and different amounts of excipients, as shown in Table 3. Add excipients and seed powder into a mortar and pestle to reduce weight, mix well, and the aggregation of powder, heap angle were evaluated. density, tap density, and Carr index are listed in Table 2. Chewable tablets were produced by a research-scale tablet die-cutting machine (Karpatavastatinvati Engineering Ltd.).

Pre-compression test :

Angle of repose: The repose angle of the powder mixture was calculated using the funnel method[22]. Pour the amount of powder mixture into a glass funnel. Adjust the height of the funnel so that the tip of the funnel touches the top of the powder mixture. The powder mixture flows freely through the funnel. Measure the diameter of the dust pile and calculate the angle of repose using the following formula [22].

$\text{Tan}\theta = h/r$

where $\text{Tan}\theta$ is the angle of repose; h is the height of the powder mass and r is the radius of the powder mass.

Determination of density and tap density: Place 20 mg powder into 100 mL graduated cylinder and observe the initial volume. The cylinder can fall from a height of 2.5 cm onto a hard surface in as little as 2 seconds. Continue until the volume does not change. The volume and tap density are calculated according to the following formula [19]:
Bulk density = W/Vo; Tapped density = W/VF
where W = weight of powder; Vo = original volume of powder; VF = final volume of powder
The ratio of impact velocity to mass density is called the Hausner ratio. A Hausner ratio > 1.25 indicates good fluidity of the powder.

Compressibility Index: Compaction Index or Carr Index is an important measure that can be obtained from dimensions and stage densities. The formula is: Carr index = (tapping speed - bulk speed) / tap speed. In order for the material to be more fluid, it must be less compressible. Materials with a value below 20% have good flow properties [19].

Quality Control tests for tablets

Weight variation: Measurement of the weight difference is made by weighing 20 tablets one by one. Average tablet weight was calculated and compared to individual weights. This procedure is followed by USP.

Tablet Hardness: The tablet's resistance to breakage under storage, transport and transport conditions before use depends on the hardness of the tablet. Test the hardness of each batch using a Monsanto hardness tester (China: Pharma Chem Machineries) by testing the tablets (how many tablets per batch). Hardness is measured in Kg/cm2.

Friability: This device uses a plastic barrel that rotates at 25 rpm, causing the tablet to break. A premeasured sample of 10 tablets is placed in the crusher at a distance of 6 inches and then run for 100 cycles, the tablets are dusted and reweighed [19]. According to the USP, to pass the test, a tablet must not lose more than 1% by weight.

% Friability = [(W1-W2)/W1]* 100

Where W1 = weight of tablets before testing

W2 = weight of tablets after testing

Disintegration test: disintegration Test disintegration using a USP II disintegration tester. Place one tablet in each tube and place the basket in a 1 liter beaker at 37 ± 20 °C. A motor drive is used to move the basket assembly containing the tablets up and down at a frequency of 5 to 6 cm. 28 to 32 cycles per minute. The time required for the tablet to completely disintegrate is recorded.

Determination of antibacterial activity: The antibacterial properties of chewable substances were calculated using the agar diffusion method [23,24]. In this way, the glass is sterilized in a hot air oven at 1600°C for 1 hour, nutrient medium is prepared and autoclaved at 1200°C for 20 minutes. Cool the environment and wait for it to freeze. Inoculate the culture by pouring the plate and using a sterile drill make a hole in the ground and place the preparation in it, this should be done in a sterile room. The nutrient medium is incubated at 370 °C for 24 hours and then the inhibition zone is measured with a reading area.

IV. DIABETES

Diabetes is a disease that occurs when your blood sugar (glucose) is too high. This occurs when your pancreas does not produce enough insulin or no insulin, or when your body does not respond to the effects of insulin. Diabetes affects people every day. Most types of diabetes are chronic (long-term), and all types of diabetes can be controlled with medication and/or lifestyle changes. Diabetes Mellitus is called Diabetes Mellitus. Other cases share the word "diabetes" (diabetes insipidus) but are different. Together they are called "diabetes" because both cause thirst and frequent urination. Diabetes insipidus is less common than diabetes mellitus.

Fig.2 Jamun Seed Powder

Types of Diabetes
There are different types of diabetes. The most common forms are:

Type 2 Diabetes: In this type, your body does not produce enough insulin and/or your cells do not respond to insulin (insulin resistance). This is the most common type of diabetes. It mostly affects adults, but children can also suffer from it.
Prediabetes: This is the stage before type 2 diabetes. Your blood sugar is higher than normal but not high enough to be diagnosed with type 2 diabetes.

a) **Type 1 Diabetes:** This type is an autoimmune disease in which your immune system attacks and destroys the insulin-producing cells in your pancreas for unknown reasons. About 10% of people with diabetes have type 1 diabetes. This disease is often diagnosed in children and adults, but it can occur at any age.
b) **Gestational diabetes:** This type occurs in some people during pregnancy. Gestational diabetes usually goes away after pregnancy. However, if you have gestational diabetes, you may have a higher risk of developing type 2 diabetes later in life.[25]

SYMPTOMS
Symptoms of delayed-onset diabetes include,

- increased thirst (polydipsia) and dry mouth. frequent urination.
- Blurred vision.
- Unexplained weight loss.
- Pain or numbness or tingling in your hands or feet.
- Slow healing sores or cuts.
- Frequent Skin and/or vaginal yeast infections.

COMPLICATION

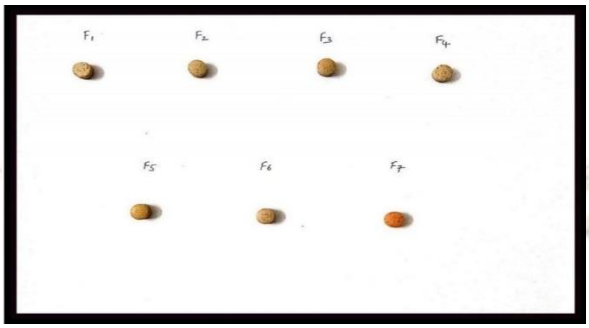
- Nerve damage (neuropathy), which may cause numbness, tingling, and/or pain. Kidney disease, which may cause kidney failure or require dialysis or transplant. Retinopathy, which can lead to blindness.
- Diabetes affects the feet.
- Skin diseases.
- Amputation.
- Sexual dysfunction caused by damage to nerves and blood vessels, such as erectile dysfunction or vaginal dryness.
- Gastroparesis.
- No hearing.

Oral health problems such as gum (periodontal) disease.

V. PREPARATION AND EVALUATION OF CHEWABLE TABLETS

Plane seed powder chewable tablets were prepared by direct compression method The ingredients of these chewable tablets are shown in Table 3. Use lactose as a diluent to increase the volume of the powder mixture. Acacia acts as a binder, holding powder materials together through adhesion or adhesion. Glucose is used as a sweetener to mask the taste of the seed powder. Talc is included as a lubricant and magnesium stearate is used as a lubricant. Although the powder mixture can be directly formed into tablets without adding binders, delamination of the tablet is not stable (also known as tablet lamination). When 50 mg (10%) binder was added, the tablet produced poor quality (<1 kg/cm2), probably due to insufficient binder. To improve the stability of the tablet, the binder concentration was increased to 17% while the dosage of other excipients remained unchanged. A total of seven formulations were prepared using a research and development scale tablet die-cutting machine (Karpatavastatinvati Engineering Ltd.). The data are presented in Table 4 by evaluating color, weight change, hardness, brittleness, thickness and disintegration time. Since F1 and F2 failed in the stage before them, all tests from F3 to F7 were carried out. The appearance of the tablet is smooth, uniform, no cracks, and its diameter is 1 cm. Weight testing is done to ensure that each tablet contains the required amount of seed powder. Tablets meet USP specifications within the specified percentage (± 5%) from a maximum of 2 tablets. All tablets are within ±10% of the average weight of the formula. Brittleness generally refers to the loss in weight of the tablet in the container due to the removal of fine particles from the tablet surface.

Brittleness often refers to the inconsistency of the capsule. Ten pieces of each recipe were tested for friability. The average weight loss of the tablet after the friability test is 1% of the average weight of the sample; This indicates that the tablet has physical stability when subjected to impact and damage. The hardness test is done to measure the strength of tablets because they need to be strong enough to be packaged and transported, but not so hard that they make chewing difficult. The hardness range is 2.5-3.0 kg/cm2. The tablet thickness from F3 to F7 was determined to be 0.76 to 0.78 cm, which may affect the explosion. The disintegration time of the chewable tablet should be short enough to prevent the patient from choking if the tablet is not chewed completely. Six tablets of each formulation were tested for disintegration. The disintegration time of the tablets is 22 to 25 minutes. All formulations F3 through F7 were found to be stable and meet United States Pharmacopoeia (USP) quality control standards for chewable tablets. However, it is worth noting that F6 formula contains pigments that enhance its appearance.[25]



Sr. No	Evaluation test	Test values
1	Bulk density	0.107gm/ml
2	Tapped density	0.110gm/ml
3	Angle of repose	26.5
4	Husner's ratio	1.1
5	Car's index	7.69

Table 2 :Flow properties of formulation for chewable tablets

EVALUATION

parameter	F1	F2	F3	F4	F5	F6	F7
Color	Lamination was observed. This may be due to lack of binder	Poor hardness due to insufficient binder	Buff				
Pale yellow			P	P	P	P	P
Hardness			2.5±0.1	3.0±0.1	2.8±0.2	3.0±0.1	3.0±0.2
Friability			P	P	P	P	P
Thickness (cm)			0.76±0.01	0.76±0.01	0.78±0.01	0.77±0.01	0.77±0.01
Disintegration time(min)			25±0.5	25±0.5	22±0.5	22±0.3	23±0.5
Diameter (cm)			1	1	1	1	1

VI. RESULTS AND DISCUSSION

Phytoconstituents	Test performed/reagents used	Result	Water extract	Methanol extract	Acetone extract
Alkaloids	Mayer's test	Cream color precipitate	+	+	+
	Dragendorff' s test	Orange brown precipitate	+ +	+	+
Steroids	Salkowski test	Red color	+	+	+
Flavonoids	Flavonoids test	Yellow(NaOH) to colorless(HCl)	+	+	+
Tannins	Ferric chloride	Dark green precipitate	+	+	+
Saponins	Saponin test	Foam formation	+	+	+
Glycosides	Molish test	No purple ring formation	-	-	-
Proteins and amino acids	Biuret test	Violet color	+	+	+
Reducing sugar	Benedict test	No brick red color	-	-	-
	Fehling' s test	No brick red color	-	-	-

' +' indicates presence of the Phytoconstituents, ' ++' indicates present in more quantity of thePhytoconstituents, ' –'indicates absence of the Phytoconstituents.

VII. CONCLUSION

Formulation and evaluation of Syzygium sylvestris seed powder chewable tablets. Preformulation studies were conducted to improve the composition of the tablet powder blend. FTIR studies showed no interaction between seed powder and tablet excipients. Antibiotic studies have shown that this preparation has antibacterial properties against Escherichia coli and Bacillus subtilis. Chewable tablet formulations can be used as nutraceuticals.

VIII. REFERENCES

[1] Venkateswarlu G. On the nature of colouring matter of the jambul fruit (Eugenia jambolana). J Indian Chem Soc, 29: 434- 437, (1952)

[2] Warrier PK, Nambiar VPK, Ramankutty C. Indian medicinal plants. Hyderabad India: Orient Longman Ltd. 1996;5:225-228.

[3] Li L, Zhang Y, Seeram NP. Structure of anthocyanins from Eugenia jambolana fruit. Nat Prod Comm 2009;4:217-219.

[4] Indira G, Mohan RJ. National Institute of Nutrition, Indian Council of Medical Research Hyderabad. 1993;34-37.

[5] Kusumoto I, Nakabayashi T, Kida H, Miyashiro H, Hattori M, Namba T, et al. Screening of various plant extracts used in ayurvedic medicine for inhibitory effects on human immunodeficiency virus type 1 (HIV-1) protease. Phytotherapy Res 1995;9:180-184.

[6] Bhuiyan MA, Mia MY, Rashid MA. Antibacterial principles of the seed of Eugenia jambolana. Banga J Botany 1996;25: 239-241.

[7] Ravi K, Sivagnanam K, Subramanian S. Anti-diabetic activity of Eugenia jambolana seed kernels on streptozotocin-induced diabetic rats. J Med Food 2004;7:187-191.

[8] Teixeira CC, Pinto LP, Kessler FHP, Knijnik L, Pinto CP, Gastaldo GJ, Fuchs FD. The effect of Syzygium cumini (L.) Skeels on postprandial blood glucose levels in non-diabetic rats and rats with streptozotocin-induced diabetes mellitus. J Ethnopharmacol 1997;56:209-213.

[9] Bhandary MJ, Chandrashekar KR, Kaveriappa KM. Medical ethnobotany of the siddis of Uttara, Kannada district, Karnataka, India. J Ethanopharmacol 1995;47:149-158.

[10] Jagetia GC, Baliga MS. Syzygium cumini (Jamun) reduces the radiation induced DNA damage in the cultured human peripheral blood lymphocytes: A preliminary study. ToxicolLett 2002;132:19- 25.

[11] Nadkarni KM. Indian materia medica. Bombay: Popular Prakashan Ltd. 1976.

[12] Morton J. Jambolan. In: Morton JF (Ed) Fruits of warm climates. 1987;375-378.

[13] Achrekar S, Kaklij GS, Pote MS, Kelkar SM. Hypoglycemic activity of Eugenia jambolana and Ficus bengalensis: Mechanism of action In Vivo 1991;5:143-147.

[14] Migliato KF. Standardization of the extract of Syzygium cumini (l.) skeels fruits through the antimicrobial activity. Caderno de Farma´ cia 2005;21(1):55-56.

[15] The Wealth of India, Council of Scientific and Industrial Research. New Delhi.1954.

[16] Joshi SG. Medicinal plants. New Delhi: Oxford & IBH Publishing Co. 2001

[17] Sushesh Srivatsa Palakurthi*, Deeksha Jakka, Durga Nithya PinnamrajuPreparation and Evaluation of Oral Thin Films of a Natural Product: Syzygium cumini seed powderJournal of Drug Delivery and Therapeutics[65] 5343-Article Text-15546-1-10-20220214.pdf

[18] Chagas V.T., et al., Syzygium cumini (L.) skeels: a prominent source of bioactive molecules against cardiometabolic diseases. Front Pharmacol, 2015; 6:259.

[19] Pal AK, Nagaich U, Bharti C, Gulati N, Formulation and Evaluation of Nutraceutical Tablet using Herbal drugs by Direct Compression Method. Journal of Drug Delivery & Therapeutics, 2014; 4(2):47- 51.

[20] Salome AC, C.U.C.E., lkechukwu VO, Sinye AB, Calister EU, Godswill CO, Formulation and evaluation of Cymbopogon citratus dried leaf-powder tablets. African Journal of Pharmacy and Pharmacology, 2012; 6(48):3274-3279.

[21] Bharadwaj Nitin, G.S., Sharma S, Design, development and evaluation of oral herbal formulations of Piper nigrum and Nyctanthes arbortristis. International Journal Of PharmTech Research, 2010; 2(1):171-176.

[22] Sumalatha G, J.R.G., Formulation and Evaluation of Polyherbal Chewable Tablets for reducing Nicotine dependence. International Journal of Pharmacy and Biological Sciences, 2017; 7(1):115- 120.

[23] Damle MC, Bhalekar MR, Rao S, Godse M, Formulation and Evaluation of Chewable Tablets of Pomogranate Peel Extract. Journal of Drug Delivery & Therapeutics, 2019; 9(4):318-321.

[24] Bangar Raju, M.B., Indira Bairy, A novel treatment approach towards emerging multidrug resistant Enteroaggregative Escherichia coli (EAEC) causing acute/ persistent diarrhea using medicinal plant extracts. Research Journal of Pharmaceutical, Biological and Chemical Sciences, 2011; 2(1):15-23

[25] Vaishnavi S. Pawar1 , Sanika R. Pawar2Chewable Tablets of Syzygium Cumini International Journal for Research in Applied Science & Engineering Technology (IJRASET) 1230-1233doc_(1)[1].pdf