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"Wood Apple As A Functional Ingredient In Herbal Chocolate: Cardioprotective And Respiratory Health Benefits"

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Abstract: The review looks at how to create and assess herbal chocolate that includes Limoniaacidissima (wood apple) extract for its heart and lung health benefits. Limoniaacidissima is recognized for its high levels of flavonoids, tannins, and coumarins. These compounds have antioxidant, cholesterol-lowering, and bronchodilator effects. The herbal chocolate was made with cocoa powder, cocoa butter, dark chocolate, stevia, vanilla, and wood apple extract using a traditional melting and mixing method. This was followed by tempering and molding. We evaluated the formulation based on its physical and chemical properties, taste, and antioxidant levels. The product showed appealing sensory characteristics and strong antioxidant potential, thanks to the bioactive compounds it contains. Therefore, herbal chocolate can serve as both a nutritional aid and a tasty option for promoting heart and lung health.

INTRODUCTION

Nowadays, people are very health conscious and prefer to buy foods that provide both nutrition and well-being. Due to increasing consumer demand, a wide range of functional foods that offer nutrition and specific health benefits have been developed. This research aims to create and assess nutritional chocolate with a natural cardiac tonic, focusing on the health benefits of cocoa. Chocolate-related products have been used as medicine for centuries because of their flavonoids, which act as antioxidants, lower blood pressure, and balance hormones. Dark chocolate contains more antioxidants than milk or white chocolate. Chocolate has positive effects on mood, stress management, cognitive function, cardiovascular health, and energy levels. [7]

The study focuses on the formulation and evaluation of nutritious chocolate that includes powdered wood apple, a native tree of Bangladesh. The bark contains glycosides, flavonoids, tannins, and minerals that support heart health and reduce stress and anxiety. Wood apple seeds are known for their anti-inflammatory, antioxidant, and lipid-lowering properties, as well as their benefits for heart health. [7]

A chocolate base is used to make medicated chocolate, and the drug is then mixed into this base. The term "chocolate drug delivery system" refers to how the drug is released from the chocolate once it is blended in. This method is ideal for children. Wood apple, also known as Limoniaacidissima, belongs to the family Rutaceae and is one of the hardiest fruits found in semi-arid and arid regions of India. It is acidic when unripe but offers a pleasant flavor when ripe. Wood apple is native to South India and Sri Lanka. It is widely grown throughout the plains of southern Maharashtra, West Bengal, Uttar Pradesh, Chhattisgarh, and Madhya Pradesh. Common names in English include wood-apple, elephant-apple, monkey fruit, curd fruit, and kathbel. The tree is often planted as a border plant and is also found in jungles. [7]

The wood apple fruits are round to oval, measuring 2 to 5 inches (5 - 12.5 cm) in diameter, with a hard, woody, greyish-white, rough rind about ¼ inch (6 mm) thick. Each fruit weighs approximately 150 to 500 grams. The pulp accounts for 36 percent of the entire fruit. The pulp is brown, mealy, aromatic, resinous, astringent, and can taste either acidic or sweet, containing numerous small white seeds scattered throughout. The seeds contain non-bitter oil and are rich in unsaturated fatty acids. The unripe wood apple pulp has a pale gold color. Wood apple pulp has an impressively long shelf life of two months when refrigerated. The quality of the fruit depends on its physical and chemical properties and nutrient composition, which influence its market value and consumer acceptance. Wood apple has significant medicinal properties. Each part of the fruit offers health benefits. It is widely used in India as a liver and cardiac tonic, for respiratory health, and when unripe, as a remedy for diarrhea, dysentery, hiccups, sore throat, and gum diseases. The fruit pulp has anti-inflammatory, fever-reducing, and pain-relieving effects. Additionally, wood apple has antioxidant, anticancer, anti-diabetic, antimicrobial, and liver-protective properties. [3]

The fruit treats ulcers, diabetes, cancer, diarrhea, and high blood pressure. This plant has become popular because it has few side effects and a wide range of uses in both medicine and cosmetics. Fruit pulp protects against skin cancer. Mashed seedless fruit pulp can be used to treat dysentery, diarrhea, and hemorrhoids. Coumarins in L. acidissima show anti-coagulant, estrogenic, vasodilation, anti-parasitic, and antibacterial effects. Many compounds in the plant, like alkaloids, anthocyanins, and tannins, effectively treat various human diseases. The fruit also serves as a tonic for the liver and heart, and it helps with hiccups, sore throats, and gum diseases. The unripe fruit works as an astringent. Phosphorus in the fruit plays a key role in bone development, and iron in the fruit helps fight anemia and tuberculosis. The fruit of this plant is used for blood pressure, diabetes, cancer, diarrhea, and ulcers. L. acidissima has been used in various medicinal systems, both traditional and modern, to treat a range of illnesses. For example, root juice acts as a remedy for snakebites, a bark decoction rich in tannins and alkaloids is used to treat malaria, and leaf juice mixed with honey is used for fever. [3]

DRUG PROFILE

Limonia acidissima

As people become more aware of natural products, natural medicine is gaining more attention than the allopathic system. This type of medicine is free from pollution and less toxic, as it has no side effects. In

India, various systems of medicine are practiced, including Ayurveda, Siddha, Unani, Amchi, and local health traditions. These systems use many plants to treat human and animal diseases. The plants used are known as medicinal plants. Wood Apple is one of these medicinal plants. [4]

WOOD APPLE-

Biological name: -Limonia acidissima

Synonyms: - Feronia limonia, Feronia Elephantum, and Schinuslimonia

Other name: -Kavath, Kothu, Elephant apple, or Cruid fruit.[4]

FigNo.1: Wood Apple Fruit

Taxonomical Classification:

Kingdom-Plantae

Sub-kingdom-Tracheobionta

Super division-Spermatophyta

Division-Magnoliophyta

Class-Magnoliospida

Subclass-Rosidae

Order-Sapindales

Family-Rutaceae [4]

Wood Apple as a Cardio protective and Respiratory Benefit:

1.Cardioprotective Benefits –

Wood apple contains several bioactive compounds, including flavonoids, tannins, saponins, alkaloids, and polyphenols. These compounds contribute to its heart-protecting properties.

Mechanisms and Actions:

1. Antioxidant Effect:

Neutralizes free radicals and prevents oxidative damage to heart tissues. Reduces lipid peroxidation and protects cardiac cells from stress.

2. Hypolipidemic Activity:

Helps lower LDL (bad cholesterol) and triglycerides while raising HDL (good cholesterol) levels. Improves lipid metabolism and prevents atherosclerosis.

3. Anti-inflammatory Effect:

Flavonoids and phenolics reduce inflammation in heart tissues. They protect against heart inflammation and cell damage.

4. Antithrombotic Action:

Prevents abnormal blood clot formation and improves circulation.

5. Overall Effect:

Improves heart efficiency, blood flow, and oxygen supply. This helps lower the risk of high blood pressure and ischemic heart disease.

2.Respiratory Benefits-

Wood apple has been used in traditional Ayurvedic and herbal medicine for a long time. It helps manage respiratory issues like asthma, bronchitis, cough, and congestion.

Mechanisms and Actions:

1. Expectorant Activity:

Helps loosen and remove mucus from the respiratory tract. This relieves congestion.

2. Anti-inflammatory and Antimicrobial Properties:

Reduces inflammation of the respiratory mucosa and stops bacterial growth.

3. Antioxidant Protection:

Protects lung tissues from oxidative stress caused by pollution or infection.

4. Bronchodilator Effect:

Some active compounds, like alkaloids and flavonoids, help relax bronchial muscles. This makes breathing easier for asthma patients.

5. Immunity Booster:

Rich in vitamin C and polyphenols, wood apple improves immune defense and prevents repeated respiratory infections. [21]

MEDICINAL USES

1. The fruit is widely used in India as a liver tonic and to treat certain heart problems.
2. Half-ripe fruit is likely the most effective remedy for dysentery. To treat diarrhea or piles, the mashed pulp of the fruit is used without the seeds.
3. An infusion of wood apple leaves is an effective remedy for peptic ulcers. Wood apple leaves are high in tannin, which reduces inflammation and helps heal ulcers.

4. It is also helpful in preventing breast and uterine cancer and in treating infertility caused by low levels of the progesterone hormone.

5. The flesh of the ripe fruit can also help treat stomach upsets in children.

6. The bark of the tree is useful for biliousness. It can be taken in pulverized form or as a decoction. The juice of the leaves can also be applied to skin rashes caused by biliousness.

7. The root of the bael tree is used at home to address various ear problems.

8. In Ayurveda, all parts of the wood apple plant are used to treat snake bites.

9. 100 grams of the fruit's pulp provides 140 calories, making it a good energy booster.

10. The wood apple is also used to treat kidney issues like stones.

11. The leaves of the wood apple help prevent and treat colds and other respiratory issues. The fruit is also effective for sore throats and chronic coughs.

12. The wood apple contains carotene, which is good for eye health.[2]

OTHER USAGE

1. The fruit's shell is made into snuffboxes and other small containers.

2. Interestingly, the gum from the trunk and branches has edible and medicinal properties, and it is used as glue. It flows out in large amounts after the rainy season.

3. The gum, mixed with lime, waterproofs wells and walls. It also protects oil paintings when applied as a coat onto the canvas.

4. The fruit rind produces oil that is popular as a fragrance for hair; it also creates a dye used to color silks and calico.

5. The wood is yellow-gray or whitish, hard, heavy, and durable. This makes it suitable for construction, patternmaking, agricultural tools, rollers for mills, carving, rulers, and other products. It also serves as fuel.

6. The wood apple's pulp has a soap-like effect, which led to its use as a household cleaner for hundreds of years.

7. The sticky layer around the unripe seeds acts as a household glue and is also used in jewelry making. [2]

PHARMACOLOGICAL APPLICATIONS OF LIMONIA ACIDISSIMA [5]

Sr No	Plant Parts	Pharmacological Uses
1	**Fruit**	Tonic for the liver and lungs Astringent; Effective against Diarrhoea, Dysentery;Throat and disease of gums Hearts weakness, Hepatitis,Wounds, Respiratory disease, Carcinomas,Lowering cholesterol levels
2	**Leaves**	Antiemetic,Antimicrobial,Hepatoprotective,Antivenom,Carminative, Dysentery, Anti Allergic, Cure peptic ulcer, Treatment for uterine cancer, Breast cancer, Infertility, Progesterone shortage, Respiratory illnesses and the flu , Traditional use in snake bite.
3	**Seed**	Cure heart disease,Headache .
4	**Pulp**	Detoxification, Decrease weight .
5	**Gum**	Demulant, Constipation, Anti-diarrheal, Anti-haemorrhoidal properrties.
6	**Bark**	Venomous wounds.

Table no.1Pharmacological applications of *Limonia acidissima*

AIM AND OBJECTIVES

AIM : "Wood Apple as a Functional Ingredient in Herbal Chocolate: Cardioprotective and Respiratory Health Benefits"

OBJECTIVES :

The experiment will be conducted to achieve the following:

1. To study the potential health benefits of wood apple.
2. To examine the respiratory and digestive properties of wood apple.
3. To review the nutritional content (carbohydrates, fats, proteins, and minerals) of the herbal chocolate.
4. To evaluate the antioxidant potential of the wood apple extract.

REVIEW OF LITERATURE

1.Dubele P, Dhakre C, Tompe V (2025)-

The wood apple was one of the many edible fruit plants that were still underutilized in India despite their immense medicinal value against a variety of human ailments. In Ayurvedic medicine, the leaves, bark, roots, fruits, and seeds were widely used as a laxative and to treat a variety of illnesses, including peptic ulcers, chronic diarrhea, and dysentery. Its ethnomedicinal qualities and the presence of numerous bioactive

compounds with anti-hyperglycemic, antidiabetic, anticancer, antimicrobial, hepatoprotective, and other similar activities were also confirmed by extensive scientific research. This review mainly provided information about the nutritional values, phytochemistry, and traditional and modern pharmacological aspects of the largely underutilized and neglected wood apple. [1]

2.Srivastava R, Mishra N, Arshi, Tripathi S, Smriti, Fatima N, Mishra N (2025)-

The Feronia limonia (L.) Swingle was an overlooked tropical fruit that contained several vitamins, minerals, and active compounds, yet it did not receive much attention. The fruit was edible at all stages—unripe, intermediate, and ripe—but was used only in a few recipes. This study aimed to examine the fruit's chemical makeup, phytochemical content, and antioxidant activity across these three stages. Since the fruit is consumed from unripe to ripe, the research shows the scientific basis for its health benefits at each stage. The chemical composition of F. limonia fruit was analyzed at three stages, focusing on nutritional content, carbohydrate profile, and vitamin and mineral levels. The fruit's phytochemicals, including total phenolic and total flavonoid content, were measured using a spectrophotometer. Antioxidant properties wereassessed through DPPH (2,2-diphenyl-1-picrylhydrazyl radical scavenging), FRAP (ferric reducing antioxidant power), MCA (metal chelating activity), and RC (reducing capacity). Thelink between phytochemical components and antioxidant activity was explored using Pearson's correlation coefficients and multiple linear regressions.The study revealed that the levels of protein, fiber, ash, calcium, phosphorus, iron, and vitamin C declined by 44.7 percent, 47.3 percent, 18.16 percent, 20.3 percent, 8.7 percent, 32.4 percent, and 20.0 percent, respectively, as the fruit fully ripened. Sucrose (1377.2 mg/100 g) was the main sugar during the ripe stage, while fructose (668.72 mg/100 g) was the main sugar in the unripe stage. As ripening progressed, sucrose concentration increased from 288.1 mg/100 g to 1377.2 mg/100 g, while the levels of other sugars decreased. At the same time, the unripe stage showed higher antioxidant activity, followed by the intermediate and ripe stages. Both phenolic and flavonoid compounds had a strong Pearson's correlation with the fruit's antioxidant activity, including DPPH scavenging activity (0.945, 0.915), ferric reducing antioxidant power (FRAP) (0.980, 0.907), metal chelating activity (MCA) (0.953, 0.914), and reducing capacity (RC) (0.981, 0.906). The findings may help the pharmaceutical and food processing industries identify the best stage for extracting bioactive ingredients and for direct consumption. [23]

3.Yadav S, Kumar R (2025)-

Wood apple (Feronia limonia L.) is an important underused fruit globally, valued for its medicinal and religious uses. The Awadh region of Uttar Pradesh has rich biodiversity for wood apple, but its potential remains largely untapped. Researchers collected fruit samples with shoots from twenty-nine wood apple genotypes in various areas of Awadh and analyzed them for different physiological traits. The study revealed a wide range of variability in morphological and quantitative features. The fruit shape varied among genotypes; flattened, round, and oval shapes were observed. The experiment followed a Completely Randomized Design (CRD) with three replications. Observations indicated significant genetic variations, including individual fruit length (5.33–9.43 cm), fruit width (5.57–9.46 cm), fruit weight (113.26–258.86 g), spine length (1.34–3.50 cm), shell thickness (0.16–0.43 mm), seed length (4.54–8.36 mm), seed width

(1.95–4.02 mm), seed thickness (1.36–1.67 mm), seed weight per fruit (25.25–31.05 g), and number of seeds per fruit (160.0–456.0) across different genotypes. Among these genotypes, G15, G14, G13, G17, G18, and G20 were identified as promising. [27]

4.Lamkhade G, Lokhande R, Bhagwat A (2025)-

Hyperglycemia and reduced insulin action are key features of diabetes mellitus, a long-term metabolic disease that needs a diverse treatment approach. Since individual responses often vary, standard treatments, such as medication and lifestyle changes, may not fully meet the challenges of managing diabetes. As a result, alternative methods, particularly those using traditional herbal remedies, have become more popular. Notable herbal combinations being researched include apple cider vinegar, wood apple, and apple extracts. This combination is sometimes called "natural insulin" in Indian traditional medicine due to its potential blood sugar-lowering effects. Systematic research focuses on the chemical profiles and mechanisms of these treatments, showing their ability to boost insulin sensitivity, promote insulin release, and reduce glucose absorption. Insulin plays a crucial role in managing how the body uses glucose. Diabetes mellitus, marked by chronic high blood sugar, occurs when the body cannot produce insulin or when cells become resistant to insulin. There are two main types of diabetes: type 1 and type 2. Managing type 1 diabetes requires a continuous external supply of insulin, while type 2 diabetes also necessitates an external insulin supply at the earlier stages of the disease. [32]

5.Khatun. S, Sen. S (2024)-

Fruits and other parts of Limoniaacidissima Linn. (wood apple) are edible and used in different cuisines. In folk medicine, various plant parts are used to treat a range of ailments. Besides being a folk remedy, the plant has also been studied for its medicinal value. It is considered important in Ayurvedic medicine, with the fruit, leaves, seeds, gum, and bark all having medicinal uses. Researchers have examined different pharmacological properties of the plant in preclinical studies. Wood apples are also valued for their nutritional benefits. Several phenolic bioactivecompounds, including kaempferol, catechins, proanthocyanidins, vanillic acid, syringic acid, and coumaric acids, have been identified in the plant parts. This paper gives an overview of the pharmacological and phytochemical properties of Limoniaacidissima. This information mayhelp in creating new formulations or improving existing products by adding more medicinal or nutritional value. [5]

6.Shukla U, Lata R, Maji S, Razauddin, Ramesh C (2024)-

Wood apple (Feronia limonia L.; Rutaceae family), often called the poor man’s fruit in India because of its many health benefits, is native to South India and Sri Lanka. The Sanskrit word “kapittha” appears in several ancient texts, including Hinduism: An Alphabetical Guide. A Buddhist scholar referred to wood apple as an Indian fruit. The military commander and poetChavundaraya (940–989 AD) included wood apple in many medicinal remedies. It is also mentioned in Charaka Samhita and Sushruta Samhita. Wood apple has been widely planted and has grown naturally in the reserved forests of Southeast Asia, northern Malaysia, and Penang Island. In India, it is more common in places like Deccan, Maharashtra, Madhya Pradesh, Uttar Pradesh, Chhattisgarh, Bihar, Jharkhand, West Bengal, Rajasthan, Gujarat, Tamil Nadu, Andhra Pradesh, Kerala, and Odisha. However, there is notmuch data on its area and production.

Unfortunately, this lack of attention has limited its potential and put it at risk of genetic erosion, which could lead to its disappearance. Thus, it is crucial to raise awareness of its importance among the public and researchers. We also need to identify superior genotypes and production issues of wood apple for collection, conservation, evaluation, and use. This study reviews various literature on the topic. The article aims to assist future researchers in conserving and exploring the potential benefits of this crop for the public, ultimately enhancing its value for farmers. [20]

7.Khatun.S,Sen.S(2024)-

Fruits and other parts of Limoniaacidissima Linn. (wood apple) are edible and used in various cuisines. In folk medicine, different parts of the plant treat various ailments. Besides being a folk remedy, the plant has also been studied for its medicinal value. It is significant in Ayurvedic medicine, with the fruit, leaves, seeds, gum, and bark having medicinal uses. Preclinical studies have looked into the plant's different pharmacological properties. Wood apples are also appreciated for their nutritional benefits. Several phenolic bioactive compounds, including kaempferol, catechins, proanthocyanidins, vanillic acid, syringic acid, and coumaric acid, have been identified in the plant. This paper offers an overview of the pharmacological and phytochemical properties of Limoniaacidissima. This information may have aided in creating new formulations or improving existing products by adding more medicinal or nutritional value. [5]

8. Wakchoure S, Raut P.G, Jadhav S.N, DhangarH(2023)-

Plants have long been an important source of medicine. They play a key role in achieving WHO goals for the well-being of all people. As more individuals discover natural products, Limoniaacidissima L. (wood apple, elephant apple, monkey fruit) from the Rutaceae family has gained recognition for its many medicinal qualities. The main aim of this study was to identify different chemical compounds in the plant that are important for medicine. This article reviews the literature on the plant's various phytoconstituents, therapeutic benefits, pharmacological activities, ethnobotanical uses, and herbal formulations. The information gathered about this plant can be useful in multiple medical fields. [29]

9.Mahajan P, Jaspal D, Malviya A(2023)-

Textile wastewater contained a high concentration of stubborn, unfixed dyes, which are considered new pollutants. Removing various toxic dyes usually involves a mix of physical, chemical, and biological processes. Among the treatment methods described in the literature, using activated carbon to adsorb contaminants has gained significant interest. This review examined the use of biowaste from custard apple and wood apple to create adsorbents for dye removal from wastewater. Adsorbing dyes with these waste materials has shown to be cost-effective and efficient. The review also looked at the effects of factors like solution pH, initial dye concentration, adsorbent dosage, and temperature. It additionally covered the use of different adsorption kinetic models and isotherm models for dye removal. [18]

10.DyutiM, Afroz R,ShoebM(2022)-

The objective of the study was to investigate Limoniaacidissima L. (wood apple) to determine the moisture and ash content, total amount of carbohydrates, fatty acid compositions, the quantity of protein and

micronutrients (Na, K, Zn, Fe) present in wood apple grown in Bangladesh. FT-IR spectroscopy was used to pinpoint many biologically significant functional groups. The moisture and ash content obtained were 74.02 and 25.44%, respectively. Carbohydrate content determined by ultraviolet-visible (UV-Visible) spectroscopic method was 16.14 g per 100 g of dried fruit sample. The fatty acids were identified by Gas Chromatography-Flame Ionization Detector (GC-FID). The relative percentage of bound fatty acids mainly palmitoleic acid, octadecanoic acid, cis-9-oleic acid and octanoic acid were 17.33, 15.09, 15.09 and 45.09%, respectively. The amount of protein was 5.11%. The micronutrients such as Na, K, Zn, Fe present in the edible portion of wood apple measured by atomic absorption spectroscopy (AAS) were 10.40, 58.24, 0.37 and 1.67 mg per 100 g of dried sample, respectively. The fruit has long been utilized in herbal medicines and is eaten raw or processed into various products to prevent noncommunicable diseases and micronutrient deficiencies. [21]

11.Ulvie Y, Kusuma H, HandarsariE(2022)-

Wood apple, or Limoniaacidissima, contains fruit acids, vitamins, and minerals. The dry fiber of the fruit has 15% citric acid and also includes potassium, calcium, and iron salts. The seed and pulp have fats and protein. The fats include palmitic acid, oleic acid, linoleic acid, and linolenic acid, along with traces of palmitoleic and stearic acids. Researchers identified β-sitosterol, β-amirin, lupeol, and stigmasterol from the unsaponifiable matter of the seed oil. The study used descriptive research with a laboratory experimental approach to determine the content of total carbohydrates, total proteins, total fats, water, ash, and crude fiber in wood apple. The researchfound that every 100 g of wood apple contains 72.326% water, 2.144% ash, 0.00985% crude fats, 4.300% protein, 15.115% fiber, and 5.868% carbohydrates. [31]

12.Masud.P,Saeker R.K(2021)-

Wood apple was an edible fruit from the Rutaceae family that saw little use. The fruit pulp was edible and used in many food dishes worldwide. It has also been a part of traditional medicine for a long time. This review aimed to summarize the healing properties of this fruit. The fruit proved effective against several serious diseases, including cancer, diabetes, high cholesterol, and infections. It could also help treat diarrhea, ulcers, and pain. Both ripe and unripe fruits showed strong healing effects. Researchers identified phenolic compounds and flavonoids as the main sources of antioxidants responsible for these health benefits. [13]

13. Sharma.P, TenguriaRK(2021)-

In today's world, herbs play an important role in different industries because of their varied properties. India has been a rich source of many useful medicinal plants. These plants can treat a wide range of human diseases and conditions. People have recognized the healing properties of plants for thousands of years. Ayurveda is one of the oldest medical systems in the world and has contributed to the discovery of many therapeutically beneficial compounds. Limoniaacidissima is one of the most notable plants, with several medicinal and health-promoting qualities. Limoniaacidissima Linn. (synonyms: Feronia elephantum, Hesperethusacrenulata, Feronia limonia, Schinuslimonia) belongs to the Rutaceae (Citrus) family and the monotypic genus Limonia. In India, Limoniaacidissima is commonly referred to by various names such as monkey fruit, wood apple, curd fruit, elephant apple, kaitha, and kavit. It is native to India and has also

been grown in Pakistan, Bangladesh, and Sri Lanka. The leaves, bark, roots, and fruits are widely used in medicine. They are commonly used to treat chronic diarrhea, dysentery, peptic ulcers, and many other conditions. Scientific studies have increasingly supported its traditional medicinal uses and confirmed the presence of bioactive compounds in different parts of the wood apple tree. This article focuses on the morphology, nutritional value, phytochemistry, and pharmacological effects of Limoniaacidissima, which has often been overlooked and underused. [6]

14.Thakur.N,Chugh.V,Dwivedi.S.V(2020)-

Many Indian plants with significant medicinal value against various human health issues remain underused. One such plant is the wood apple, which is an edible fruit. In Ayurvedic medicine, the leaves, bark, roots, fruits, and seeds are widely used to treat chronic diarrhea, dysentery, andpeptic ulcers. They also serve as a laxative and manage many other problems. Numerous scientific studies have confirmed its traditional medicinal uses and shown the presence of a range of bioactive compounds. These compounds have antihyperglycemic, antidiabetic, anticancer, antimicrobial, hepatoprotective, and various other effects. This review mainly offers information about the nutritional value, phytochemistry, and both traditional and modern pharmacological properties of the often neglected wood apple. [3]

15.Khan M.A, Singh K, Patel K, SiddiquiM(2019)-

Wood apple, often referred to as “poor man’s food,” is native to India and has long been sought after for its medicinal benefits. However, it remains an unpopular fruit because mechanical methods for harvesting, processing, transporting, separating, packing, and removing pulp are lacking. Important physical properties such as length, breadth, thickness, arithmetic mean diameter (AMD), geometric mean diameter (GMD), specific gravity, aspect ratio, and pulp-to-peel ratio are crucial for designing and making the necessary processing equipment. In this study, the average values for length, breadth, thickness, AMD, GMD, specific gravity, aspect ratio, and pulp-to-peel ratio were found to be 72.3 mm, 66.03 mm, 56.09 mm, 65.09 mm, 64.65 mm, 89.7%, 91.78%, and 2.314, respectively. The high sphericity values, ranging from 74.3% to 99.7%, suggested that the wood apple fruit may move by a combination of rolling and sliding on flat surfaces. However, the high aspect ratio of 109.62% indicated that the wood apple would tend to roll rather than slide. The color values (L, a, b, hue, chroma, and total color change) of both raw and ripe fruits, as well as the fruit area (using Jean & Ball and McCabe methods), were also assessed. Moreover, the fruit’s weight was linked to some physical properties of wood apple for estimating its characteristics. However, the coefficient of determination (R^2) indicated a poor fit of the data. Thus, this study could provide essential information for designing machines for post-harvest processing of wood apple at a commercial level. [17]

MATERIAL AND METHOD

Materials:

Sr.No	Ingredients	Uses
1	Wood apple pulp and seed powder	Cardio protective and Respiratory benefits
2	Cocoa Powder	Anti-oxidant and Base
3	Stevia Sugar	Sweetning Agent
4	Sugar free dark chocolate	Binding Agent
5	Vanilla	Flavoring Agent
6	Cocoa Butter	stabilizer and texture enhancer

Table no.2 Ingredients and their uses

1.Wood Apple Pulp And Seed Powder:

Fig No.2: Wood Apple

Wood apple, part of the Rutaceae family, is a fruit that comes from India and Sri Lanka. It is high in tannins, phenolic compounds, flavonoids, vitamin C, and essential minerals. These components contribute to its antioxidant, antimicrobial, and heart-protective properties. [9]

Traditional uses:

Used in Ayurveda to treat digestive disorders, diarrhea, ulcers, and respiratory issues. It has antioxidant, liver-protecting, heart-protecting, and germ-fighting properties. The pulp, seed, and bark all have reported healing benefits. [9]

2.Stevia sugar:

Fig No.3: Stevia Sugar

Botanical name:-*Stevia rebaudiana*

Family :-Asteraceae

Common names:-Stevia, Sweet leaf, Honey leaf

Part used:-Leaves

Form used in formulation:-Dried leaf powder or purified steviol glycosides (mainly stevioside and rebaudioside A)

Description

Stevia is a natural, non-caloric sweetener from the leaves of the *Stevia rebaudiana* plant. It is about 200 to 300 times sweeter than sucrose (table sugar) but has zero calories. Stevia is commonly used as a natural sugar substitute in foods, drinks, and herbal products, especially for diabetic and weight-management items. [3]

Uses

As a natural sweetener, it works well in herbal chocolates, drinks, and health products.

It is suitable for diabetic-friendly formulations since it has no effect on blood sugar levels.

It is used in pharmaceutical syrups and chewable tablets to improve taste without adding calories.

It is also included in weight-loss diets as a healthy sugar alternative. [3]

Health Benefits

Controls blood sugar and insulin levels.

Helps with weight management by lowering calorie intake.

Supports oral health by preventing cavities.

Reduces oxidative stress and improves heart health.

Safe for long-term use, approved by WHO and FDA for food applications. [3]

3.Dark Chocolate:

Fig No.4: Dark Chocolate

Common Name: Cocoa tree / Cacao tree

Family: Malvaceae

Part Used for Chocolate Production: Seeds (cocoa beans) of the fruit (cacao pod)

1. Description

Dark chocolate is a type of chocolate that has a high percentage of cocoa solids, usually between 50 and 90%. It includes cocoa butter and a small amount of sweetener. Unlike milk chocolate, it does not have milk solids, which gives it a bitter-sweet taste and a strong chocolate flavour. People appreciate it not just for its taste but also for its nutritional benefits and health properties. [10]

2. Uses

In herbal formulations, it serves as a base and flavouring agent for herbal or nutraceutical chocolates.

In pharmaceuticals, it acts as a carrier for bitter herbal extracts or nutraceutical compounds.

In cosmetics, it is used in skincare products for antioxidant and anti-aging benefits. In the food industry, it is an ingredient in energy bars, desserts, and beverages. [10]

3.Health Benefits

Supports heart health and lowers the risk of cardiovascular diseases.

Acts as a natural mood booster and stress reliever.

Offers antioxidant protection against aging and cell damage.

Improves brain function and memory.

May help with weight management when eaten in moderation. [10]

4.Vanilla:

Fig No.5:Vanilla

Scientific Name: *Vanilla planifolia* Andrews

Family: Orchidaceae

Part Used: Cured and dried fruit pods (vanilla beans)

1.Why Vanilla is Used as a Flavouring Agent

Vanilla is one of the most popular natural flavouring agents in the world. It brings a sweet, creamy, and pleasant smell to different pharmaceutical and food products. The main active compound in vanilla, vanillin, is what gives it its unique flavour and scent. [12]

Uses of Vanilla as a Flavouring Agent

1.In Pharmaceutical Formulations-

Used to mask bitter or unpleasant tastes of drugs, especially in syrups, suspensions, chewable tablets, and oral drops.

It adds a pleasing taste to pediatric medicines.

It is used in nutraceutical and herbal chocolates as a natural flavour booster.

It works well with ingredients like cocoa, milk, and sweeteners such as stevia or sorbitol.

2. In Food and Beverage Industry-

Commonly used in chocolates, ice creams, bakery items, and beverages.

It improves flavour harmony by balancing sweet and bitter tastes.

It also boosts the sensory appeal of dairy and confectionery products. [12]

5.Cocoa Powder:

Fig No.6: Cocoa Powder

Scientific Name OF Source Plant: *Theobroma cacao* L.

Family: Malvaceae (formerly Sterculiaceae)

Common Name: Cocoa, Cacao powder, Chocolate powder

1.Uses

In herbal and functional chocolates, it serves as a base, flavouring, antioxidant, and natural colorant.

In pharmaceuticals, it is used in nutraceutical formulations for cardiovascular and antioxidant benefits.

In cosmetics, it is used in skin creams and masks for antioxidant and rejuvenating effects.

In beverages and foods, it is an ingredient in energy drinks, health supplements, and desserts. [8]

2.Health Benefits

Protects against oxidative stress and heart disease.

Improves mood and energy. Boosts blood circulation and brain health.

Supports gut bacteria balance.

Promotes skin glow and elasticity.

Too much may cause nervousness or insomnia because of caffeine.

Should be used in moderate amounts in formulations. [8]

6. Cocoa Butter:

Fig No.7: Cocoa butter

Scientific Name (Source Plant): *Theobroma cacao* L.

Family: Malvaceae (formerly Sterculiaceae)

Common Names: Cocoa fat, Theobroma oil, Cacao butter

Pharmaceutical Uses:

Used as a base for suppositories and ointments; it melts at body temperature.

It serves as a carrier for topical and cosmetic products.

It provides skin-softening and emollient effects.

It acts as a stabilizer and improves texture in herbal chocolate formulations.

It has moisturizing and antioxidant properties. [11]

METHOD OF PREPARATION:[7]

1.Preparation of Wood Apple Extract / Pulp:

Break the hard shell of a ripe wood apple.

Scoop out the pulp, remove the seeds, and filter it through a muslin cloth.

If you want, prepare an extract by heating the pulp with distilled water or ethanol (1:10 w/v) for 1 hour.

Then, filter and concentrate it.

2. Melting of Chocolate Base:

Melt dark chocolate and cocoa butter in a double boiler at 45 to 50 °C.

Stir continuously to get a smooth mixture.

3. Addition of Ingredients:

Add cocoa powder and mix well.

Slowly incorporate wood apple pulp or extract while stirring.

Add a natural sweetener, such as stevia or honey, and mix evenly.

Add a few drops of vanilla or cardamom for flavor.

4. Molding:

Pour the warm mixture into silicone or steel molds.

Gently tap the molds to remove air bubbles.

5. Cooling and Solidification:

Cool the molds in the refrigerator at 4 to 8 °C for 30 to 60 minutes.

Let the chocolates set and harden completely.

6. Demolding and Storage:

Carefully take the chocolates out of the molds.

Store them in airtight containers in a cool, dry spot to keep them from melting and absorbing moisture. [7]

EVALUATION PARAMETERFOR CHOCOLATE [15]

1.General appearance:

a) Colour

b) Odour

c) Taste

d) Texture

2.Hardness:

Hardness of chocolate was measured by Monsanto Hardness Tester.

3.PH :

2 grams of prepared chocolate were dissolved in 100 milliliters of phosphate buffer solution.

The pH of the resulting solution was measured with a digital pH meter using a glass electrode.

4.Chemical test:

a. Test for Carbohydrate (Fehling's Test):

To 1 ml of the solution, equal amounts of Fehling's solution A and B were added and heated. The formation of a brick red precipitate indicates the presence of carbohydrates.

b. Test for Protein:

Take 3 ml of the chocolate formulation. Add 4% NaOH and a few drops of 1% copper sulfate solution. A violet color indicates the presence of protein.

c. Test for Amino Acids (Ninhydrin Test):

3 ml of the test solution was heated. Add 3 drops of 5% Ninhydrin solution to the boiling water and boil for 10 minutes. A purple and bluish color indicates the presence of amino acids.

d. Test for Saponin (Foam Formation):

Place 2 ml of the chocolate formulation in water. Add this to a test tube, shake well, and if stable foam forms, it indicates the presence of saponin.

5. Blooming test :

a. Fat bloom:

When a thin layer of fat crystals forms on the surface of the chocolate formulation, it causes the chocolate to lose its shine. A soft white layer appears, making the final product look unappetizing. Fat bloom happens due to the recrystallization of fats or the movement of a filling fat to the chocolate layer. Keeping the chocolate at a steady temperature will delay the onset of fat bloom.

b. Sugar bloom:

This is a rough and uneven layer on top of the chocolate. Sugar bloom happens when condensation forms after the chocolate is taken out of the refrigerator. This moisture dissolves the sugar in the chocolate. When the water evaporates, the sugar recrystallizes into rough, uneven crystals on the surface. This gives the chocolate an unpleasant appearance. Each sample went through treatment cycles that included (1) 30°C for 11 hours, (2) a temperature change for 1 hour, (3) 18°C for 11 hours, and (4) another temperature change for 1 hour. The chocolate formulation observed shows whether blooming occurred after the 11-hour step.

6. Stability:

The stability studies of the formulated product were conducted at 25/75 (°C/RH) and 2-8°C for one month. The chocolate was packaged in aluminum foil paper, and the sensory properties included color, odor, taste, mouthfeel, and appearance.

CONCLUSION

Wood Apple chocolate offers a new way to combine traditional herbal medicine with modern functional foods. With careful formulation and testing, this product could become an important tool in preventing and managing heart disease, as well as providing respiratory benefits. Future plans include expanding the product line, improving absorption, personalizing formulas, and incorporating these products into heart-healthy diets. Wood apple has bioactive compounds like flavonoids, tannins, saponins, and phenolics, which help protect the heart, provide antioxidants, reduce inflammation, and support respiratory health. When added to dark chocolate, a natural source of antioxidants and mood boosters, this combination creates

a functional and healthy treat. The herbal chocolate showed good taste, stability, and nutrient content, indicating its potential as a health product. This study shows that herbal chocolate with wood apple can be a new, natural, and beneficial choice for promoting heart and respiratory health while offering a tasty and nutritious food option.

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