SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 5 | May 2024 - Peer Reviewed Journal

# FORMULATION AND EVALUATION OF ANTIDIABETIC HERBAL CHOCOLATES CONTAINING GUAVA LEAVES AND AEGLE MARMELOS LEAVES

**Najmin Ansar Shaikh[1*], Sakshi Omprakash Jaju[2], Anand Daulatrao Khendke[3]**

[1]*Student of Bachelor in Pharmacy, Faculty of Pharmacy,Dr.Babsaheb Ambedkar Technological University, Raigad,Lonere.*
[2]*Department of Pharmaceutics , Faculty of Pharmaceutics , Dr.Babsaheb Ambedkar Technological University , Raigad, Lonere*
[3]*Student of Bachelor in Pharmacy, Faculty of pharmacy , Dr. Babasaheb Ambedkar Technological University , Raigad, Lonere.*

**Corresponding Author*

**ABSTRACT**

*The consumption of chocolate is enjoyed by people of all ages, yet health concerns such as obesity, high blood pressure, diabetes, and coronary artery disease persist. The aim of the present study was to formulate medicated chocolate containing herbal ingredients aimed at preventing diabetes and providing diabetic patients with a convenient chocolate option. Psidium guajava, also known as guava leaves, is rich in antioxidants and vitamins that aid in lowering blood sugar levels. Aegle marmelos, synonymous with Bael leaves, contains high levels of flavonoids and alkaloids, which also contribute to reducing blood sugar levels. The formulation of herbal chocolates included guava leaf powder, Bael leaf powder, dark chocolate, sucrose, coffee, cocoa butter, cardamom powder, and sodium benzoate. The prepared chocolate formulations were evaluated for parameters such as hardness, pH, general appearance, colour, texture, chemical composition, weight variation, melting point, and physical stability.*

**KEYWORDS:** *Herbal chocolate, Guava leaves, Aegle Marmelose leaves, cocoa butter, Dark chocolate, Sodium Benzoate, Cardemom.*

## INTRODUCTION

Diabetes is a chronic disease which caused by a metabolic disorder characterized by fast increasing of blood sugar level (high blood glucose).[1]Insulin, a hormone produced by the pancreas, plays a key role in regulating blood sugar levels by facilitating the uptake of glucose from the bloodstream into cells for energy production or storage.[2]

### 1.1 Types of Diabetes

1. **Type 1 Diabetes**: This results from the immune system mistakenly attacking and destroying insulin-producing beta cells in the pancreas. As a result, the body produces little to no insulin, leading to elevated blood sugar levels. Type 1 diabetes typically develops in children and young adults, requiring lifelong insulin therapy for management.[3]

2. **Type 2 Diabetes:** This is the most common form of diabetes, accounting for the majority of cases. It occurs when the body becomes resistant to insulin or gradually loses the ability to produce enough insulin to maintain normal blood sugar levels. Type 2 diabetes is often associated with lifestyle factors such as obesity, physical inactivity, and poor dietary habits. It can develop at any age, but it is more common in adults.

3. **Gestational Diabetes:** This type of diabetes occurs during pregnancy when the body cannot produce enough insulin to meet the increased demand. Gestational diabetes increases the risk of complications during pregnancy and childbirth, and women who develop it are at higher risk of developing type 2 diabetes later in life.[4]

4. **Other Specific Types:** There are other less common forms of diabetes, including genetic mutations affecting insulin production or action, diseases of the pancreas, drug-induced diabetes, and diabetes associated with certain medical conditions.[5

5. **Common symptoms of diabetes include**
   - Increased thirst and urination
   - Fatigue
   - Blurred vision

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 5 | May 2024 - Peer Reviewed Journal

- Unintentional weight loss
- Slow-healing wounds
- Tingling or numbness in the hands and feet
- Recurrent infections, particularly of the skin, gums, or urinary tract

Complications of diabetes can affect various organs and systems in the body, leading to serious health issues if left untreated or poorly managed. Some of the complications include:

- **Cardiovascular diseases:** Diabetes increases the risk of heart disease, stroke, and peripheral artery disease.
- **Nerve damage (neuropathy):** High blood sugar levels can damage the nerves, leading to pain, numbness, and weakness, particularly in the hands and feet.
- **Kidney damage (nephropathy):** Diabetes is a leading cause of kidney failure, requiring dialysis or kidney transplantation.
- **Eye damage (retinopathy):** Diabetes can cause damage to the blood vessels in the retina, leading to vision loss or blindness if untreated.
- **Foot complications:** Nerve damage and poor circulation can increase the risk of foot ulcers, infections, and eventual amputation.[6]

Management of diabetes typically involves a combination of lifestyle modifications, medication, and regular monitoring. Treatment goals aim to achieve and maintain optimal blood sugar levels, prevent or delay the onset of complications, and improve overall quality of life. Lifestyle interventions include adopting a healthy diet, engaging in regular physical activity, maintaining a healthy weight, and avoiding tobacco use.

Regular monitoring of blood sugar levels, blood pressure, cholesterol levels, and kidney function is essential for effective diabetes management. Self-management education and support programs can also help individuals with diabetes learn to effectively manage their condition and make informed decisions about their health.

Prevention strategies for type 2 diabetes include maintaining a healthy weight, being physically active, eating a balanced diet rich in fruits, vegetables, whole grains, and lean proteins, and avoiding excessive consumption of sugary beverages and processed foods. Early detection and treatment of prediabetes can also help prevent or delay the onset of type 2 diabetes.[7]

Overall, diabetes is a complex and challenging condition that requires comprehensive management strategies to prevent complications and optimize health outcomes. With proper education, support, and access to healthcare resources, individuals with diabetes can lead fulfilling and productive livers.[8]

In recent years, there has been a growing interest in developing food products that not only satisfy culinary cravings but also offer potential health benefits, especially for individuals managing chronic conditions like diabetes. One such innovative endeavor is the formulation and evaluation of an antidiabetic herbal chocolate. This comprehensive study delves into the intricate process of creating a chocolate blend infused with the therapeutic properties of guava leaves and Aegle marmelos leaves powder, along with the complementary flavours and functionalities of dark chocolate, saccharin, coffee, cocoa butter, cardamom, and sodium benzoate.

The selection of ingredients in this formulation is deliberate, aimed at achieving a harmonious balance between taste, texture, and health-promoting properties. Guava leaves and Aegle marmelos leaves powder are chosen for their well-documented antidiabetic effects, containing bioactive compounds such as polyphenols and flavonoids that have shown promise in regulating blood sugar levels and improving insulin sensitivity.[9]

Dark chocolate, with its rich cocoa content, is not only a source of indulgence but also a reservoir of antioxidants, which may help mitigate oxidative stress associated with diabetes. To maintain sweetness without adversely affecting blood glucose levels, saccharin, a non-nutritive sweetener, is incorporated into the formulation.

Coffee, another ubiquitous ingredient, adds depth of flavor and complexity to the chocolate blend while potentially offering additional benefits for individuals with diabetes. Studies have suggested that coffee consumption may be associated with a reduced risk of type 2 diabetes, attributed in part to its bioactive compounds such as chlorogenic acids and trigonelline, which may improve glucose metabolism and insulin sensitivity.[10]

Cocoa butter, derived from the cocoa bean, serves as the fat component of the chocolate, imparting a smooth and creamy texture while contributing beneficial fatty acids and antioxidants. Cardamom, a fragrant spice with a long history of medicinal use, lends its distinct aroma and flavor to the formulation, enhancing the sensory experience of the chocolate blend.

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 5 | May 2024 - Peer Reviewed Journal

To ensure the stability and shelf-life of the product, sodium benzoate, a commonly used preservative, is included in the formulation. Its antimicrobial properties help prevent microbial growth and spoilage, preserving the integrity of the herbal chocolate blend over time.[11] Through a rigorous evaluation process encompassing sensory analysis, stability testing, and assessment of antidiabetic efficacy, this study aims to validate the quality and effectiveness of the formulated chocolate blend. By marrying culinary creativity with evidence-based nutrition and medicinal science, this research endeavor seeks to offer a delectable and health-conscious option for individuals seeking diabetic-friendly indulgences.[12]

In recent years, there has been growing interest in developing food products that offer potential health benefits, particularly for individuals managing chronic conditions like diabetes. One such innovative endeavor is the formulation and evaluation of antidiabetic herbal chocolate. This study aims to create a chocolate blend infused with the therapeutic properties of guava leaves and Aegle marmelos leaves powder, along with complementary flavours and functionalities of dark chocolate, saccharin, coffee, cocoa butter, cardamom, and sodium benzoate.

These ingredients are selected for their potential antidiabetic effects and their ability to enhance the sensory characteristics of the chocolate blend. Through rigorous evaluation, including sensory analysis, stability testing, and assessment of antidiabetic efficacy, this research aims to validate the quality and effectiveness of the formulated chocolate blend as a diabetic-friendly indulgence.

## OBJECTIVES

1) To formulate antidiabetic chocolate suitable for individuals of all ages affected by diabetes.
2) To regulate blood sugar levels and reduce the long-term risk of diabetes.
3) To reduce reliance on medicated drugs by providing an alternative antidiabetic option.
4) To create a chocolate blend incorporating guava leaves and Aegle marmelos leaves powder to leverage their antidiabetic properties.
5) To evaluate the sensory attributes of the herbal chocolate, including taste, aroma, texture, and appearance, to ensure consumer acceptability.
6) To optimize the formulation to achieve a balance between taste, health benefits, and product stability, ultimately providing a diabetic-friendly indulgence.
7) To overcome intake of medicated drugs to get antidiabetic activity.

**Need of Work**

- The formulation and evaluation of antidiabetic herbal chocolate incorporating guava leaves, Aegle marmelos leaves powder, dark chocolate, sucrose, coffee, cocoa butter, cardamom, and sodium benzoate is imperative to address the growing demand for innovative, health-conscious confectionery options.
- The diabetes prevalence on the rise globally, there is an urgent need for delicious yet blood sugar-friendly treats. By integrating antidiabetic herbs like guava leaves and Aegle marmelos leaves powder, alongside sucrose as a sugar substitute, this formulation offers a natural solution to blood sugar regulation.
- Additionally, the inclusion of dark chocolate provides antioxidant benefits, while coffee and cardamom enhance flavor and potentially offer further health advantages. Preserving product stability and safety is essential, hence the utilization of sodium benzoate as a preservative.

**Application:-**

**1)Antidiabetic Herbal Chocolate** : These can be marketed as a convenient snack option for individuals managing diabetes or those looking to regulate their blood sugar levels.[13]

**2)Sugar-Free Chocolate Spread**: This spread can be positioned as a guilt-free option for people looking to reduce their sugar intake. It can be used as a topping for toast, pancakes, or fruit, providing a sweet chocolate flavor without the added sugars.[14]

**3) Nutritious Meal Replacement** : These can be positioned as a convenient and balanced option for individuals managing diabetes as part of their dietary regimen. Packed with nutritious ingredients including dark chocolate, cocoa butter, herbal powders, and coffee, they provide a satisfying snack or meal replacement option while also supporting blood sugar control.[15]

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 5 | May 2024 - Peer Reviewed Journal

**Drug Profile & Excipients Profile**

1. **Guava Leaves:**

**Fig . 1 :- Guava leaves**

- **Biological name**:- Psidium Guajava
- **Family:-** Myrtaceae

**Taxonomical Information:**

- **Kingdom:** Plantae
- **Order**: Myrtales
- **Family:** Myrtaceae
- **Genus:** Psidium
- **Species:** Psidium Guajava [16]

- **Pharmacology:-**

Guava leaves (Psidii guajavae folium) are known for their various medicinal properties, including antispasmodic, cough sedative, anti-inflammatory, antidiarrheic, antihypertensive, antiobesity, and antidiabetic effects. Studies on animal models have also shown the potential of guava leaves isolates as antitumor, anticancer, and cytotoxic agents.[17]

**Uses:**

1. Control blood sugar levels.
2. Boost the immune system.
3. Improve skin health.
4. Help lower blood sugar levels by improving insulin production and sensitivity.

2. **Aegle Marmelos Leaves:**

**Fig. 2 :- Aegle Marmelos leaves**

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 5 | May 2024 - Peer Reviewed Journal

- **Common Name:** Bael, Bilwa
- **Biological Name:** Aegle Marmelos
- **Family:** Rutaceae

- **Taxonomical Information:**

- **Kingdom:** Plantae
- **Order**: Sapindales
- **Family:** Rutaceae
- **Species:** Aegle Marmelos
- **Class:** Dicotyledons
- **Genus:** Aegle correa [18]

**Pharmacological Activity**

Aegle marmelos leaves have been reported to possess various pharmacological activities. They are known for their hypoglycemic (blood sugar-lowering) properties, making them valuable in managing diabetes. Studies have shown that the dried powder of A. marmelos leaves lowers blood sugar levels in streptozotocin-induced diabetes rat models by boosting insulin secretion from pancreatic beta cells.[19]

**Uses:**

**1) Blood sugar regulation** :- Aegle Marmelose leaves are belived to have hypoglycemic properties , making them beneficial for individuals with diabetes or those looking to regulate blood sugar levels.[20]

**2) Digestive Health:-** The leaves are known for their digestive properties, aiding in digestion and relieving gastrointestinal issues such as constipation and indigestion.

**3) Immune system support :-** Aegle Marmelose leaves contain antioxidants and immune boosting compounds that may help strengthen the immune system and protect against infection.[21]

**4) Anti inflammatory effects:-** The leaves have anti inflammatory properties, which can help reduce inflammation in the body and alleviate related symptoms.[22]

**Excipients Profile:-**

**3. Dark Chocolate:**

Dark chocolate is rich in polyphenols, which possess antioxidant properties and may aid in regulating blood sugar levels.

**4. Coffee:-**

Coffee is used as a flavor enhancer and contains compounds such as chlorogenic acids and antioxidants that have been studied for their potential antidiabetic effects.

**5. Cocoa Butter:**

Cocoa butter serves as a solidifying agent in chocolate, contributing to its gloss, texture, and typical melting behaviour..

**6. Sucrose:**

Sucrose acts as a sweetening agent in the formulation.

**7. Cardamom Powder:**

Cardamom and its active constituents have been reported to control insulin secretion and help maintain normal blood sugar levels.

**8. Sodium Benzoate:**

Sodium benzoate is a preservative that inhibits the growth of bacteria, yeast, and mold in acidic foods and beverages, thereby extending their shelf life.

**Materials and Equipment**

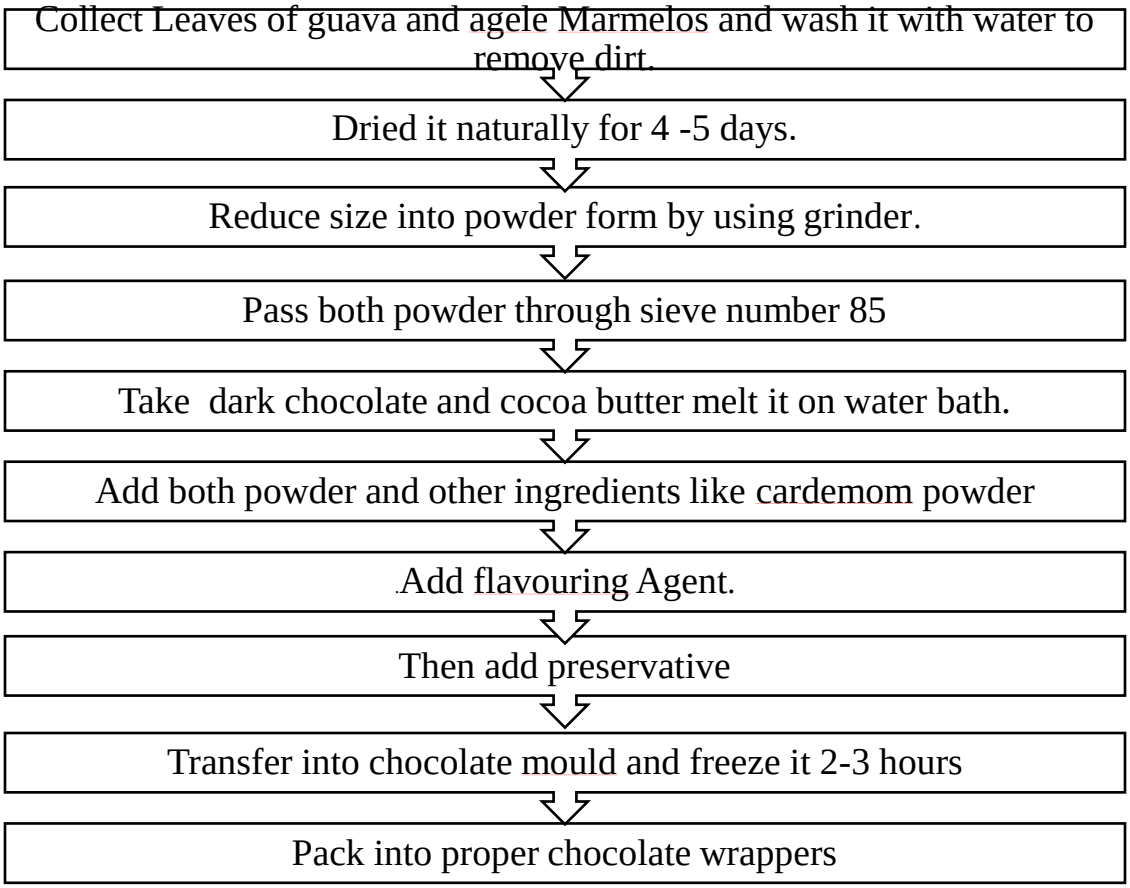
**1. Mixing Bowls:-** Used for blending and mixing the ingredients to prepare the chocolate formulation.
**2. Measuring Instruments:-** Weighing balance for accurately measuring ingredients.
**3. Blender or Grinder**:-Used to grind or blend ingredients such as guava leaves or Aegle Marmelos leaves (Bael) into powder form.
**4. Heating Apparatus:-** Water bath for melting the dark chocolate.
**5. Stirring Rods or Spatulas:-**Used for thorough mixing and homogenization of the formulation.
**6. Refrigerator:-**Used to freeze the chocolate formulation.
**7. Chocolate Mould:-** Used to give proper shape to the liquid chocolate before it sets.

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 5 | May 2024 - Peer Reviewed Journal

**Experimental work:**
**Formulation of Dark Chocolate**
**Formula**

| Sr. No. | Ingredients | Quantity Taken | | | Category |
|---|---|---|---|---|---|
| | | F1 | F2 | F3 | |
| 1 | Guava Leaves Powder | 2.5 | 2.5 | 2.5 | Antidiabetic Agent |
| 2 | Aegle Marmelose leaves powder | 2.5 | 2.5 | 2.5 | Antidiabetic Agent |
| 3 | Dark chocolate | 50 | 50 | 50 | Antioxidant |
| 4 | Cocoa butter | 2.5 | 2.8 | 03 | Solidifying agent |
| 5 | Sucrose | 2.4 | 2.4 | 2.4 | Sweetening Agent |
| 6 | Cardemom powder | 01 | 01 | 01 | Flavouring Agent |
| 7 | Coffee | 01 | 01 | 01 | Flavouring Agent |
| 8 | Sodium Benzoate | 0.05 | 0.05 | 0.05 | Preservative |

- **Steps/Methodology**



SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 5 | May 2024 - Peer Reviewed Journal

**Fig. 3:- Formulation of Chocolate**

**Evaluation Test**

**a. Physical Appearance:-**

**1. Colour:** Observe the colour visually.

**2. Texture:** Evaluate the texture of the chocolate.

**3. Mouth Feel:** Place chocolate in the mouth and feel its texture.

**4. Taste of Chocolate:** Taste the chocolate.

**5. Hardness:** Perform a hardness test by pressing a specified dimensioned and loaded object (indentor) into the surface of the material being tested. The hardness is determined by measuring the depth of indentor penetration or by measuring the size of the impression left by an indentor.[23]

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 5 | May 2024 - Peer Reviewed Journal

**6. pH:** The pH formulation was determined using digital pH meter.

**Fig. 4 :- pH Determination**

**b. Chemical Test**

**1. Test for Carbohydrate (Fehlings Test):-** A solution containing equal quantities of Fehlings solution A and B was added and heated. The formation of a brick-red precipitate indicates the presence of carbohydrates.

**2. Test for Protein (Biuret Test/General Test):-** Chocolate formulation was mixed with 4% NaOH and a few drops of 1% copper sulphate solution. The formation of a violet color indicates the presence of protein.

**3. Test for Amino Acids:-** The test solution was heated, and 5% Ninhydrin solution was added. Boil for 10 minutes. The formation of a purple or bluish color indicates the presence of amino acids.[24]

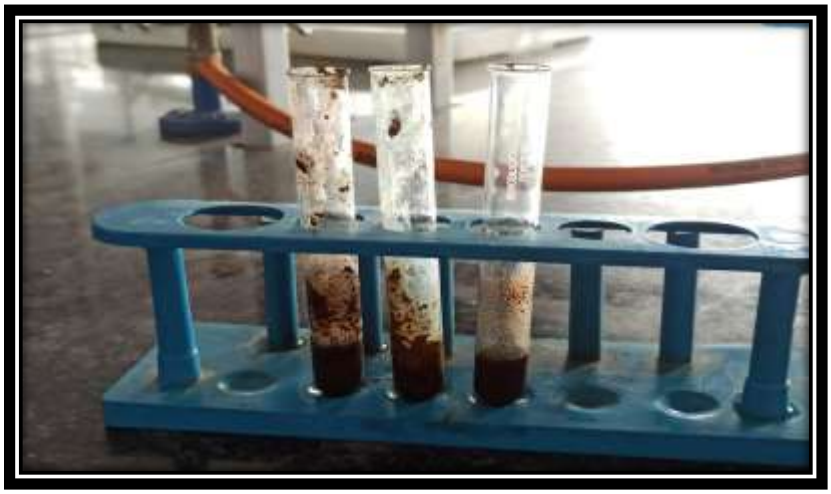


**Fig. 5:- Chemical Test**

**c. Weight Variation:-**

The weight of four chocolate recipes was weighed separately and collectively. The weight of all the chocolates was used to calculate the average weight. The average weight was then compared with the individual weights using the following formula to determine the percentage deviation.[25]

**% Deviation = Individual Weight – Average Weight / Aver6 Weight ×100**

**d. Bloom Test**

Fat Bloom Test:- The chocolate was heated to 40°C for 30 minutes and then cooled to 20°C. After being at 20°C for 8 hours, a test sample was checked to see if bloom had occurred or not.[25]

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 5 | May 2024 - Peer Reviewed Journal

**Fig. 6 :-Observation from bloom test of chocolate**

**e. Physical Stability**

To check physical stability, samples of chocolate were kept in closed containers for 1 month at 28°C. After 1 month, test samples of chocolate were observed for physical appearance and drug degradation.[26]

## RESULTS & DISCUSSION

| Sr. | Test | F1 | F2 | F3 |
|---|---|---|---|---|
| 1) | Colour | Dark Brown | Dark Brown | Dark Brown |
| 2) | Texture | Smooth | Smooth | Smooth |
| 3) | Taste | Sweet | Sweet | Sweet |
| 4) | Consistency | Solid | Solid | Solid |
| 5) | pH | 6.8 | 6.4 | 6.5 |
| 6) | Stability | Stable | Stable | Stable |
| 7) | Environmental impact assessment | Biodegradable | Biodegradable | Biodegradable |
| 8) | Aroma test | Sweet and floral | Sweet and floral | Sweet and floral |

**1. Colour:-** The chocolate formulations (F1, F2, and F3) exhibited a consistent dark brown colour, indicating uniformity in the chocolate preparation process.
**2. Texture:-**All formulations showed a smooth texture, suggesting proper blending and homogenization of ingredients.
**3. Taste:-** The chocolates were uniformly sweet in taste across all variations (F1, F2 and F3 ), indicating balanced sweetness levels.
**4. Consistency:-** The consistency of the chocolates was solid, indicating proper solidification during the cooling process.
**5. pH:** The pH values of the formulations were within a close range (6.4 to 6.8), indicating slight variation but overall stability in acidity levels.
**6. Shelf Life Test:** All formulations were tested for shelf life at room temperature, suggesting potential stability in storage conditions.
**7. Environmental Impact Assessment:-** The chocolates were found to be biodegradable, indicating their eco-friendly nature and minimal environmental impact.
**8. Aroma Test:-**The chocolates exhibited a sweet and floral aroma, enhancing the sensory experience for consumers.

## CONCLUSION

Based on the study conducted, it can be concluded that the natural active constituents present in guava leaves powder and Aegle Marmelos leaves extract exhibit superior inhibition against diabetic activity compared to commercially available antidiabetic chocolate. Among the formulations tested, batch S3 emerged as the optimized batch, providing satisfactory sweetening properties, pH levels, and stability profile.

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 5 | May 2024 - Peer Reviewed Journal

The incorporation of herbal ingredients such as guava leaves powder and Aegle Marmelos leaves powder into the chocolate formulation proved successful, as these ingredients contain active constituents like flavonoids and phenolic compounds known for their antidiabetic properties. Additionally, the inclusion of dark chocolate in the formulation is beneficial for improving insulin sensitivity and regulating blood sugar levels, potentially reducing the risk of type 2 diabetes and improving glucose metabolism.

Furthermore, the dosage range of the herbal extracts used in the formulation ensures safe consumption without risking any side effects. Overall, the study highlights the potential of herbal chocolates enriched with guava leaves and Aegle Marmelos leaves extracts as a safe and effective option for managing diabetes. Further research and clinical trials may provide additional insights into their efficacy and long-term effects on diabetes management.

## REFERENCE

1. *Sable Kundan Dattatraya, Sable Kiran Dattatray, Kathwate Ganesh Sunil, Mane Snehal Suryakant. "Formulation and Evaluation of Herbal Antidiabetic Tablet." Asian J. Res. Pharm. Sci. 2020; 10(3):145-148. Doi: 10.5958/2231-5659.2020.00027.2*
2. *Rahman, S., & Parvin, R. (2014). "Therapeutic Potential of Aegle marmelos (L.): An Overview." Asian Pacific Journal of Tropical Disease, 4, 71-77. https://doi.org/10.1016/S2222-1808(14)60318-2*
3. *McLachlan, K., Jenkins, A., & O'Neal, D. (2007). "The role of continuous glucose monitoring in clinical decision-making in diabetes in pregnancy." Aust N Z J Obstet Gynaecol. 47:186-190.*
4. *U. Galicia-Garcia, A. Benito-Vicente, S. Jebari, A. Larrea-Sebal, H. Siddiqi, K.B. Uribe, H. Ostolaza, C.J. Martín. "Pathophysiology of type 2 diabetes mellitus." Int. J. Mol. Sci. 21(17), 6275. 10.3390/ijms21176275.*
5. *Shirur Dakappa Shruthi, Adhikari Roshan, Sanjay Sharma Timilsina, & Sajjekhan Sunita. "A Review on the medicinal plants Psidium Guajava linn. (Myrtaceae)." Journal of Drug Delivery & Therapeutics; 2013, 3(2), 162-168.*
6. *Blanco-Montenegro I., Ritis R., & Chiappini M. "Imaging and modelling the subsurface structure of volcanic calderas with high-resolution aeromagnetic data at Vulcano (Aeolian Islands, Italy)." Bull. Volcanol. 2007; 69(6):643–659. Doi: 10.1007/s00445-006-0100-7.*
7. *Hargreaves, S.M., Raposo, A., Saraiva, A., & Zandonadi, R.P. (2021). "Vegetarian Diet: An Overview through the Perspective of Quality of Life Domains." Int. J. Environ. Res. Public Health 18, 4067.*
8. *Type 1 diabetes mellitus and cardiovascular disease: a scientific statement from the American Heart Association and American Diabetes Association. De Ferranti SD, de Boer IH, Fonseca V, et al. Diabetes Care. 2014;37:2843–2863.*
9. *Kitabchi, A.E., Umpierrez, G.E., Miles, J.M., & Fisher, J.N. (2009). "Hyperglycemic crises in adult patients with diabetes." Diabetes Care 32(7):1335–1343.*
10. *Aidoo, R.P., Afoakwa, E.O., & Dewettinck, K. (2015). "Rheological properties, melting behaviours and physical quality characteristics of sugar-free chocolates processed using inulin/polydextrose bulking mixtures sweetened with stevia and thaumatin extracts." LWT Food Sci Technol. 62(1):592–597. Doi: 10.1016/j.lwt.2014.08.043.*
11. *Trendafilova A., Ivanova V., Rangelov M., et al. (2020). "Caffeoylquinic Acids, Cytotoxic, Antioxidant, Acetylcholinesterase and Tyrosinase Enzyme Inhibitory Activities of Six Inula Species from Bulgaria." Chem. Biodivers. 17: e2000051. Doi: 10.1002/cbdv.202000051.*
12. *Yuvasri, S., Chand, P. K., Kishore, P., Kumar, K. K., Kaviya, S., & Kalpanashree, K. (2023). "Formulation and Evaluation of Chocolates Containing Papaya." International Journal of Pharmaceutical Research and Applications, 8(3), 2596-2599.*
13. *Thakare, D. R., & Dhumal, P. G. (2023). "Preparation and Evaluation of Herbal Chocolate." International Journal of Advanced Research in Science, Communication and Technology (IJARSCT), 3.*
14. *Aidoo, R.P., Afoakwa, E.O., & Dewettinck, K. (2015). "Rheological properties, melting behaviours and physical quality characteristics of sugar-free chocolates processed using inulin/polydextrose bulking mixtures sweetened with stevia and thaumatin extracts." LWT Food Sci Technol. 62(1), 592–597. Doi: 10.1016/j.lwt.2014.08.043.*
15. *Blanco-Montenegro, I., Ritis, R., & Chiappini, M. (2007). "Imaging and modelling the subsurface structure of volcanic calderas with high-resolution aeromagnetic data at Vulcano (Aeolian Islands, Italy)." Bull. Volcanol. 69(6), 643–659. Doi: 10.1007/s00445-006-0100-7.*
16. *Shirur Dakappa Shruthi, Adhikari Roshan, Sanjay Sharma Timilsina, & Sajjekhan Sunita. (2013). "A Review on the medicinal plants Psidium Guajava linn. (Myrtaceae)." Journal of Drug Delivery & Therapeutics; 3(2), 162-168. Available online at http://jddtonline.info.*
17. *Kumar, M., Tomar, M., Amarowicz, R., Saurabh, V., Nair, M.S., Maheshwari, C., Sasi, M., Prajapati, U., Hasan, M., Singh, S., Changan, S., Kumar Prajapat, R., Berwal, M.K., & Satankar, V. (2021). "Guava (Psidium guajava L.) Leaves: Nutritional Composition, Phytochemical Profile, and Health-Promoting Bioactivities." National Library of Medicine, Published online Apr. Doi: 10.3390/foods10040752.*
18. *Nigam, V., & Nambiar, V.S. (2015). "Therapeutic Potential of Aegle Marmelos (L.) correa Leaves as an antioxidant and antidiabetic agent: A Review." International Journal of Pharma Sciences and Research, 6(3), Mar.*
19. *Monika, S., Thirumal, M., & Kumar, P.R. (2023). "Phytochemical and biological, Review of Aegle Marmelos Linn." National Library of Medicine, Published online Mar 23. Doi: 10.2144/fsoa-2022-0068.*
20. *Bisht N., Vinita, & Johar, V. (2017). "Bael (Aegle marmelos) extraordinary species of India: a Review." Int. J. Curr. Microbiol. Appl. Sci. 6(3), 1870–1887.*
21. *Afoakwa, E.O., Paterson, A., Fowler, M., & Ryan, A. (2008). "Flavor Formation and Character in Cocoa and Chocolate: A Critical Review." Crit. Rev. Food Sci. Nutr. 48, 840–857.*

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 5 | May 2024 - Peer Reviewed Journal

22. *Trendafilova A., Ivanova V., Rangelov M., Todorova M., Ozek G., Yur S., Ozek T., Aneva I., Veleva R., Moskova-Doumanova V., et al. (2020). "Caffeoylquinic Acids, Cytotoxic, Antioxidant, Acetylcholinesterase and Tyrosinase Enzyme Inhibitory Activities of Six Inula Species from Bulgaria." Chem. Biodivers. 17, e2000051. Doi: 10.1002/cbdv.202000051.*
23. *Yuvasri, S., Khushal Chand, P., Kishore, P., Kishore Kumar, K., Kaviya, S., & Kalpanashree, K. (2023). "Formulation and Evaluation of Chocolates Containing Papaya." International Journal of Pharmaceutical Research and Applications, Volume 8, Issue 3, May-June, pp. 2596-2599. ISSN: 2249-7781. Available online at www.ijprajournal.com.*
24. *Thakare, D.R., & Dhumal, P.G. (May 2023). "Preparation and Evaluation of Herbal Chocolate." International Journal of Advanced Research in Science, Communication and Technology (IJARSCT), Volume 3, Issue 5.*
25. *Dwivedi, M., Jha, K.K., Pandey, S., Sachan, A., Sharma, H., & Dwivedi, S.K. (2022). "Formulation and Evaluation of Herbal Medicated Chocolate in Treatment of Intestinal Worms and Related Problems." International Journal of Food and Nutritional Science, Journal volume 11, Issue 2.*
26. *Ghuge, J.R., & Kale, V.R. (January-February 2023). "Formulation and Evaluation of Antidiabetic Chocolate By using Guava Leaves and Mulberry Fruits." International Journal for Multidisciplinary Research, Volume 5, Issue 1-2.*