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Formulation and Evaluation of Antihypertensive and Antidiabetic Herbal Medicated Chocolate

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Abstract:- Chocolate is one of the world's most cherished indulgences, enjoyed by people of all ages and backgrounds. The present study explores the development of a novel herbal chocolate enriched with Ashwagandha (Withania somnifera) and Flaxseeds (Linum usitatissimum), focusing on its potential health benefits and functional properties. The primary ingredients selected for this study were Ashwagandha (Withania somnifera), flaxseeds (Linum usitatissimum), Nuts (Prunus dulcis and Anacardium occidentale), and Cardamom (Elettaria cardamomum).

- ***Objective***

The prime objective of present study was to formulate the chocolate containing drug i.e. herbal chocolate for hypertension and diabetes patients without compromising taste of chocolate.

- ***Method***

The formulation process involved optimizing the concentrations of Ashwagandha and flaxseeds to maintain the sensory qualities of chocolate while maximizing health benefits. Further prepared medicated chocolate is evaluated for general appearance, dimension, hardness, blooming test. The formulation and evaluation of an anti-hypertensive and anti diabetic herbal chocolate were undertaken using a combination of natural ingredients with well-documented therapeutic benefits.

- ***Result***

In terms of physical examination, dimensions, texture, and hardness, every herbal formulation produced satisfactory results. Formulated chocolate passes the bloomimg test. It also passes test for carbohydrates, test for proteins, ph.

- ***Conclusion***

Drug compliance, bioavailability and patient compliance are the major factors increased by inexpensive medicated Chocolate.

Keywords:- *Herbal Chocolate, Hypertension, Diabetes, Ashwagandha (Withania Somnifera), Flaxseeds (Linum Usitatissimum), Nuts (Prunus Dulcis And Anacardium Occidentale), Cardamom (Elettaria Cardamomum).*

I. INTRODUCTION

One of the finest delivery methods for patient compliance is oral. In Oral route of drug administration, the drug is taken by mouth and absorbed through the stomach or intestines into the bloodstream. It's easy to administer and generally well-accepted by patients. Patients can take oral medications on their own, without needing healthcare personnel.

A chocolate delivery system refers to the incorporation of active ingredients or functional compounds into chocolate, enhancing its nutritional or therapeutic value while maintaining its sensory appeal. This system allows for the precise delivery of health-promoting substances, such as vitamins, minerals, herbs, or antioxidants, in a palatable form. By combining indulgence with wellness benefits, chocolate delivery systems offer a novel approach to functional foods that cater to both taste and health-conscious consumers.

Herbal Chocolate is a new product that combines the delicious taste of chocolate with the goodness of herbs. It is considered a symbol of happiness and perseverance. But because chocolate is often high in sugar and fat, health-conscious consumers are starting to look for other ways to help them reach their goals. But this study will help them to reach their goals, without compromising their health. Herbal chocolates offer consumers desserts that nourish the body and soul, with their careful design and emphasis on quality.

As various research`s are showing that many people are being suffering from hypertension and diabetes, Mostly teenagers and old people. In this world, the only thing everyone enjoys is chocolate. Hence, this study has been performed to formulate herbal chocolate to treat hypertension and diabetes. Ashwagandha, a well-known adaptogen, is traditionally used to reduce stress and lower blood pressure. Its anti-inflammatory and antioxidant properties have shown promise in improving blood glucose control and enhancing overall metabolic function. Flaxseeds, rich in omega-3 fatty acids, lignans, and fiber, are recognized for their ability to improve insulin sensitivity and manage cholesterol levels, contributing to both anti-hypertensive and anti-diabetic effects. Nuts, such as almonds (Prunus dulcis) and cashews (Anacardium occidentale), provide heart-healthy fats, protein, and micronutrients that support blood sugar regulation and maintain healthy blood pressure. Medicated chocolate is prepared by using chocolate base and the drug is incorporated into prepared chocolate base.

Hypertension, or high blood pressure, is a chronic medical condition where the force of the blood against the walls of the arteries is consistently too high. Hypertension is classified into two main types: primary (essential) hypertension, which has no clear cause and develops gradually over time, and secondary hypertension, which results from an underlying condition such as kidney disease, endocrine disorders, or the use of certain medications. The global prevalence of hypertension has been steadily increasing, making it a major risk factor for cardiovascular diseases, including stroke, heart attack, and heart failure.

Diabetes is a chronic metabolic disorder characterized by high blood sugar levels, either due to insulin resistance or insufficient insulin production. Type 1 diabetes occurs when the immune system attacks insulin-producing beta cells in the pancreas. In contrast, Type 2 diabetes is often linked to lifestyle factors such as poor diet, lack of physical activity, and obesity. Early diagnosis and management are crucial in preventing complications such as cardiovascular disease, nerve damage, and kidney failure. Treatment for diabetes typically involves medication, insulin therapy, and lifestyle changes. Advances in continuous glucose monitoring and insulin delivery systems have improved patient outcomes. However, the ultimate goal remains to find a cure or more effective long-term management strategies.

Fig 1: Chocolate

II. DRUG PROFILE

A. Ashwagandha (Withania somnifera) –

➢ *Chemical Constituents –*

- *Withanolides:* These are steroidal lactones and the primary active compounds in Ashwagandha.
- *Alkaloids:* Alkaloids such as somniferine, withanine, and anaferine contribute to Ashwagandha's sedative and relaxant effects, supporting its role in stress reduction and mental relaxation.
- *Saponins:* Saponins like sitoindosides and withanosides are adaptogenic compounds that help the body manage stress and improve cognitive function and endurance.
- *Flavonoids:* These antioxidants help neutralize free radicals, reducing oxidative stress and supporting heart and brain health.
- *Amino Acids:* Amino acids in Ashwagandha, including tryptophan, contribute to its mood-enhancing and calming effects by influencing serotonin levels.

➢ *Potential Health Benefits –*

- *Adaptogenic properties:* Help the body adapt to stress.
- *Reduced anxiety and stress:* It improve mood and reduce cortisol levels.
- *Improved cognitive function:* Enhance memory and attention.
- *Enhanced immune function:* Support the immune system.
- *Increased muscle mass and strength:* Aid in muscle growth and recovery.
- *Lowered blood sugar levels:* Have potential benefits for blood sugar control.

Fig 2: Ashwagandha

B. Flaxseeds (Linum usitatissimum) –

➢ *Chemical Constituents –*

- *Omega-3 Fatty Acids (Alpha-Linolenic Acid* - ALA): A beneficial polyunsaturated fatty acid linked to heart health.
- *Lignans:* Flaxseeds contain high levels of lignans, phytoestrogens that have antioxidant properties and are thought to support hormonal balance.
- *Fiber:* They are a good source of both soluble and insoluble fiber, aiding in digestion, promoting satiety, and supporting blood sugar regulation.

➢ *Potential Health Benefits –*

- *Rich source of omega-3 fatty acids:* Support heart health and reduce inflammation.
- *High in fiber:* Aid in digestion and promote satiety.
- *Help to lower cholesterol levels:* Some studies suggest it may reduce LDL cholesterol.
- *May improve hormone balance:* Help to regulate hormone levels, especially in women.

Fig 3: Flaxseeds

C. Almonds (Prunus dulcis) –

- *Key Compounds: Monounsaturated fats, protein, fiber, vitamin E, magnesium.*
- *Biological Classification :-*

- *Kingdom* – Plantae
- *Phylum* – Angiosperms
- *Class* – Eudicots
- *Order* – Rosales
- *Family* – Rosaceae
- *Genus* – Prunus

Almonds are high in monounsaturated fats, fiber, and antioxidants, which can help reduce LDL cholesterol, improve blood lipid levels, and support overall cardiovascular health.

- *Potential Benefits –*

- Heart-healthy fats: Help lower bad cholesterol and reduce the risk of heart disease.
- Protein source: Aid in muscle growth and repair.
- Fiber-rich: Promote digestive health and satiety.
- Antioxidant properties: Vitamin E may protect cells from damage.
- May help regulate blood sugar: Improve insulin sensitivity and reduce blood sugar spikes.

Fig 4: Almonds

D. Cashews (Anacardium Occidentale) –

- *Key Compounds: Monounsaturated fats, protein, fiber, magnesium, copper.*
- *Biological Classification :-*

- Kingdom – Plantae
- Phylum – Angiosperms
- Class – Eudicots
- Order – Sapindales
- Family – Anacardiaceae
- Genus – Anacardium

Cashews are a source of essential fatty acids and antioxidants that help protect brain cells from oxidative stress,etc.

- *Potential Benefits –*

- *Heart-healthy fats:* Help lower bad cholesterol and reduce the risk of heart disease.
- *Protein source:* Aid in muscle growth and repair.
- *Fiber-rich:* Promote digestive health and satiety.
- *May improve bone health:* Magnesium and copper may support bone density.
- *Immune Support:* High in zinc, cashews help boost the immune system, supporting the body's defense mechanisms against infections and aiding wound healing.
- *May reduce the risk of gallstones:* Help prevent gallstone formation.

Fig 5: Cashews

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Table 1: List of Ingredients used in Herbal Medicated Chocolate.

SR.NO.	INGREDIENTS	HERBAL USES
1.	Dark Compound	Antioxidant properties, heart health benefits, and mood enhancing effects.
2.	Ashwagandha	Reduce stress, improve energy levels, support immunity, and enhance overall vitality
3.	Flaxseeds	Support digestive health, reduce inflammation, balance hormones, and improve heart health.
4.	Almonds	Provide a rich source of healthy fats, antioxidants, and fiber, supporting heart health, brain function, and digestion
5.	Cashews	Enhance flavor with their rich, creamy texture and antioxidant properties.
6.	Cardamom	Provides a unique aromatic flavour.
7.	Honey	Used as a natural sweetener with antimicrobial, antioxidant, and soothing properties, enhancing both flavor and health benefits.
8.	Flavonoids	Offer antioxidant, anti-inflammatory, and mood-enhancing benefits, and give a unique aroma.

Table 2: Composition of Ingredients in Herbal Chocolate.

INGREDIENTS	F1	F2
Dark Compound	30 gm	30 gm
Ashwagandha	15 gm	15gm
Flaxseeds	15 gm	15 gm
Almonds	8 units	8 units
Cashews	8 units	8 units
Cardamom	6 units	6 units
Honey	4 tbsp	4 tbsp
Flavonoids	5ml	5ml

III. METHODOLGY

A. Extraction Procedure:

➢ *Extraction Process for Ashwagandha Powder –*
Ashwagandha dried roots were taken from laboratory storage.

- *Cleaning:* Wash the ashwagandha dried roots thoroughly to remove any dirt or debris.
- *Grinding:* Break the dried roots into smaller pieces, then grind them in a grinder or blender to create a fine powder. For a smoother consistency, grind in small batches.
- *Sifting:* Use a fine mesh sieve to sift the powder, removing any large or coarse pieces. You can re-grind these larger pieces if needed.
- *Storage:* Store the ashwagandha powder in an airtight container.

➢ *Extraction Process of Flaxseeds powder –*
Flaxseeds were taken from local grocery market.

- Measure Flaxseeds: Decide how much flaxseed powder you want to make.
- Grinding: Add the whole flaxseeds to a coffee grinder, blender, or spice grinder. Grind the seeds until you achieve a fine, powdery consistency. This usually takes 10-15 seconds.
- Storage: Transfer the flaxseed powder to an airtight container.

➢ *Ashwangandha Powder and Flaxseeds Powder were Extracted as Per Requirements to Prevent Wastage of Materials.*

Fig 6: Ashwagandha Extract

Fig 7: Flaxseeds Extract

B. Herbal Chocolate Preparation Method:

- *Roast the Nuts* – Lightly roast the almonds, cashews in an oven at 150°C for 10-15 minutes, then let it be cool. Make medium pieces of almonds and cashews by using mortar pestle to enhance crunchy feel in chocolate.
- *Melt the Dark compound* – Break the dark compound into small chunks. Use a double boiler or microwave method to melt the compound. Stir it simultaneously, to avoid overheating. Once melted, remove it from heat and stir until smooth.
- *Add Ashwagandha Powder* – Once the dark compound is melted, add ashwagandha extract (powder) as per requirement. Ensure even distribution to maximize their benefits. Stir until well combined. •
- *Add Flaxseeds Powder* – Add flaxseeds extract (powder) as per requirement. Ensure even distribution to maximize their benefits. Stir until well combined. •
- *Add Roasted Nuts* – Once the above mixture is mixed well, add the almonds and cashews medium pieces. Stir it well so that nuts can be mixed properly in a mixture. •
- *Flavor with Cardamom and Honey* - Add cardamom powder for flavor, and mix in honey to sweeten the chocolate. Adjust sweetness as needed. Stir the mixture properly so that every ingredient will be evenly mixed. •
- *Add Flavonoids* – Add some drops of rose flavonoids to enhance the aroma and presentation of herbal chocolate. •
- *Pour and Set:* Pour the chocolate mixture into molds and let it cool at room temperature. For faster setting, place the molds in the refrigerator for 30 minutes to 1 hour until firm.

Fig 8: Dark Chocolate

Fig 9: Ashwagandha Powder

Fig 10: Flaxseeds Powder

Fig 11: Nuts and Cardamom

Fig 12: Herbal Chocolate Poured in Moulds and Kept for Frozen.

Fig 13: Herbal Medicated Chocolate

C. Evaluation Tests

- *Organoleptic Properties*: Organoleptic properties refer to the sensory attributes of herbal chocolate, encompassing taste, aroma, texture, appearance, and overall mouthfeel, which contribute to the consumer's experience. These properties are crucial in herbal chocolate as they determine its appeal and acceptability, especially when incorporating unique ingredients like ashwagandha, cardamom, flaxseeds, and rose flavonoids.
- *Test of hardness:* The chocolate should be hard enough to break in diameter. The hardness of chocolate is a good indicator of its strength. Hardness is measured with a Monsanto hardness tester. kg/cm2 is used to express numbers.
- *Test for Carbohydrates (Molisch Test):* The Molisch test is a chemical test used to detect the presence of carbohydrates in a sample, including those in herbal chocolate. It relies on a reaction between carbohydrates and a reagent, typically consisting of alpha-naphthol, in the presence of concentrated sulfuric acid. When the Molisch reagent is added to the herbal chocolate extract, it mixes with the sulfuric acid to form a purple or violet ring at the interface if carbohydrates are present.
- *Test for Protein:* The protein test of herbal chocolate is a laboratory procedure used to determine the protein content in the chocolate formulation. This analysis is important for evaluating the nutritional value of the product, especially when ingredients like ashwagandha, flaxseeds, almonds, and cashews known for their protein content are included.
- *Blooming Test:* The blooming test of herbal chocolate assesses the appearance of surface "bloom" – a whitish or grayish layer that can form on chocolate due to fat or sugar crystallization issues. Blooming typically occurs from temperature fluctuations, improper storage, or issues in the chocolate-making process. The test involves storing chocolate under controlled conditions and observing for bloom formation over time, helping ensure a smooth, appealing appearance and maintaining flavor and texture.
- *Physical Stability:* To check the physical stability, sample of chocolate was kept in closed container for 1 month at 28°C after one month interval, Test sample of chocolate was observed for physical appearance and drug degradation.

IV. RESULTS AND DISCUSSION

Table 3: Organoleptic Properties

SR.NO.	PARAMETERS	OBSERVATION
1.	Colour	Dark Brown
2.	Odour	Chocolate with no brunt, no smoky smell
3.	Taste	Slightly sweet, Creamy
4.	Texture	Smooth , Crunchy

A. Test of Hardness –

- Initial reading on hardness tester = 3.5 kg/cm
- After breakage of chocolate = 7.5kg/cm
- Therefore, hardness present in the chocolate formulation = 8.5 kg/cm -3.5kg/cm i.e. 4kg/cm

Hence, Hardness of herbal medicated chocolate is 4kg/cm.

B. Test for Carbohydrates –

Place 2-3 drops of the sample in a test tube. Add 2-3 drops of Molisch reagent to the test tube. Add concentrated sulfuric acid along the sides of the test tube to form a layer beneath the solution.

Appearance of purple colour indicates the presence of carbohydrates.

C. Test for Protein –

Add 1-2ml of the sample solution into a clean test tube. Add 2ml of sodium hydroxide solution to it. To that add 5-6 drops of cooper sulphate solution to it.

Appearance of bluish violet colour indicates the presence of protein.

Table 4: Blooming Test

SR.NO.	TEST	RESULT
1.	Fat Bloom	No
2.	Sugar Bloom	No
3.	Texture Bloom	No

Table 5: Physical Stability

Parameter	Storage condition	At the time of preparation	After the one month
Colour, odour, taste, appereance	28°C in closed container.	Dark brown, chocolate with no brunt, no smoky smell, slightly sweet, creamy, smooth, crunchy	No change

V. CONCLUSION

The study on the formulation and evaluation of anti-hypertensive and anti-diabetic herbal chocolate was a comprehensive exploration of incorporating natural, health-boosting ingredients into a universally loved treat. This herbal chocolate was carefully crafted using ingredients like Ashwagandha, flaxseeds, almonds, cashews, cardamom, honey, and rose flavonoids, each chosen for its unique therapeutic properties. Throughout the formulation process, careful attention was paid to balancing the flavors of these medicinal ingredients with the rich taste of chocolate, ensuring a palatable and appealing final product. Various tests were conducted to assess the nutritional and functional qualities of the herbal chocolate. The blooming test confirmed the absence of fat and sugar blooms, indicating a stable and high-quality product. Protein and carbohydrate tests showed the presence of these essential nutrients. Herbal extracts of ashwagandha and flaxseeds were successfully extracted. Medicinal extracts are safe when taken in large amounts as they have no side effects. Chocolate formulation provides a palatable means for delivering medicaments through oral delivery. And from all the above formulation and evaluation studies, we can say that the study of formulation and evaluation of antihypertensive and antidiabetic herbal medicated chocolate by using ashwagandha, flaxseeds, nuts, cardamom is successfully done.

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