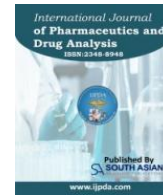




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PREPARATION AND EVALUATION OF MULTIPURPOSE MEDICATED CHOCOLATE

Rajesh Mokate*¹, Jayashree Kokat¹, Aher Puja Garje Aarti¹, Agarkar Prerana¹, Badadhe Sandip², Wadghane Somnath¹

¹Abasaheb Kakade College of Pharmacy Bodhegaon

²Kakasaheb Mhaske college of Pharmacy Ahmednagar

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Abstract

Purpose: The primary objective of current study was to create a chocolate formulation incorporating medicinal herbal ingredients for multiple uses. **Method:** The method includes extraction of herbal material and mixing to prepare syrup to formulate chocolate.

Result: Viscosity Determination of Chocolate Base: It is determined by Brookfield viscometer and observed to be 560cp viscosity = 0.40kg/ms. The amount of force needed to break the tablet may be found using a Monsanto Hardness Tester or a Pfizer Hardness Tester and is found to be 0.2 Kg/cm². No Flat or Sugar Bloom observed. The formulation is stable at 2-80C.

Conclusion: According to the results, the chocolate made the mixture feel velvety smooth. Additionally, it effectively disguised the medicine's bad taste, giving it a more appealing choice for consumption. In addition, the medicated chocolate demonstrated therapeutic effectiveness and showed potential as an oral drug delivery mechanism. It shows antitussive, anti-diabetic, anti-inflammatory, and antiviral properties and hence used as multipurpose chocolate.

Keywords: Medicated chocolate, anti-diabetic, anti-inflammatory, anti-oxidants..

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*Corresponding Author

Rajesh Mokate

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Introduction

A semisolid suspension of sugar, cocoa, and, depending on the variety, milk solids (about 70% total) suspended in a continuous lipid phase is what makes up a chocolate. Beans harvested from the fruit of *Theobroma cacao* are the source of cocoa solids. The majority of cocoa beans grown are of the Forastero variety, which is identified by tiny, flattish, and purple beans. Trinitario, a disease-resistant hybrid of Criollo and Forastero, is highly regarded as a flavour bean; output of Criollo is now low. There are three main varieties of chocolate: dark, milk, and white. The percentage of cocoa solids, milk fat, and cocoa butter in each kind varies. Carbohydrates, lipids, and proteins end up in different quantities because of this. As a result of differences in business procedures and national customer tastes, chocolate production methods

may vary widely. Central to chocolate's flavour, the composition of its continuous phase lipids affects its melting qualities and how it feels in the tongue. Saturated stearic acid(35%), palmitic acid(28%), and monounsaturated oleic acid (37%). These make up the bulk of chocolate triglycerides. When eaten, chocolate melts from its solid state at room temperature (about 20–25°C) into a smooth suspension of solid particles in cocoa butter and milk fat at the oral temperature (about 37°C). The composition of lipids is so limited.

When it comes to choosing the best lipid crystal shape, the oral epithelia are quite sensitive to variations in smoothness. Despite its high sugar and fat content, chocolate is beneficial to human nutrition because it contains antioxidants, including flavonoids (epicatechin, catechin, and especially procyanidins) and polyphenols. White chocolate has a shorter shelf life than milk and dark chocolate because it does not contain cocoa nibs, which are antioxidants. A number of minerals, such as iron, potassium, magnesium, and copper, are found in chocolate.

The sensory qualities of chocolate may vary due to variations in cocoa varieties, component amounts, blending processes, processing methods, and the substitution of milk crumb for milk powder. Chocolate

types and their intended uses dictate the requirements. The sugar granules in chocolate are dissolved when the continuous aqueous phase of the oral continuous phase mixes with saliva as the chocolate melts in the mouth. The surface of the oral epithelium is coated with lipids and cocoa solids, and the way particles dissolve in the mouth affects how rough and solvable they seem. During processes like chewing, pressing the tongue, and swallowing, this happens at speeds that are proportional to the size and effort exerted. In turn, the distribution of particle sizes and the content of ingredients affect the gustatory experience and the release of oral volatiles, which in turn affect the amplitude and temporal profile of retro nasal flavour characteristics.

In order to make high-quality goods with a distinct texture, the rheological qualities of chocolate are vital. Chocolates that are quite thick leave a pasty sensation that stays in the mouth for a long time. The composition, processing method, and particle size distribution all have a role on viscosity. Flavour 'by mouth' and the intensity of taste during ingestion are affected by the apparent viscosity of aqueous solutions. Because of this, rheological measures may tell us a lot about how chocolate tastes [1, 2].

Because it is not hydrophilic, chocolate inhibits the development of microorganisms and the hydrolysis of active substances that are sensitive to water. The presence of saturated fat, polyphenols, sterols, diterpenes, triterpenes, aliphatic alcohols, and methylxanthines in its composition is responsible for its resistance. As they enter puberty, children and babies lose some of their sweetness preference compared to adults. Having a strong aversion to bitterness, especially when formed at an early age, might make it difficult to enjoy bitter flavours. Medicated chocolate and medicated lozenges are examples of novel solid dosage forms for medication delivery systems that researchers have created to circumvent the problems associated with bitter taste and protect young children from possibly dangerous intakes.

Children are especially drawn to medicated chocolate because of its more enticing texture, which increases patient consent. Because it provides an efficient and safe delivery method, this method is useful for the elderly and those with dysphagia [3].

Chocolate is a versatile food since it may be used with medications to provide new sensory experiences. The "love drug" moniker is based on fact that the naturally occurring brain chemical phenylethylamine makes people feel happy and pleased. One way to identify edible, highly caloric saccharides is by their sweetness. Medicated chocolate begins with a chocolate foundation and is then mixed with the drug. An example of a "chocolate medicine delivery system" would be a drug that is mixed into chocolate and then released when the chocolate is heated. [4].

Types of Chocolate:

1. Milk chocolate: Milk chocolate is best made using a blend of Ecuadorian and medium-roasted West African beans. This combination guarantees a pure chocolate flavour with hints of fruitiness and nuts. To maintain the intended milky undertones, it is essential to exclude the more acidic beans from Brazil and Malaysia.
2. Light milk chocolate: Lightly roasted Java beans, which are recognised for their pale colour and mild overall flavour with clear nutty undertones, may be used to make milk chocolate that is not too heavy. The coating will be notably lighter than that of a 100% West African bean, which allows milk chocolate to stand out from the crowd. This option helps achieve that goal.
3. High-quality semisweet chocolate: Because of its mild to medium roast, cocoa-characteristic West African stock is ideal for making premium semisweet chocolate. Caracas and Trinidad beans round out the blend, which provides flowery and somewhat spicy flavours, resulting in a balanced and distinctive character while cutting down on burned or bitter undertones.
4. Bittersweet chocolate: Coating very sweet and flavorful cream centres with bittersweet chocolate results in coatings with considerable bitterness.
5. Semisweet cookie drop: It is recommended to utilise dominant West African beans for semisweet cookie drop in order to provide a powerful cocoa effect. Baked cookies benefit from the rich flavour that combination of West African component and the substantial characteristics of Brazilian and Sanchez components produces [5, 6].

Therapeutic uses of Chocolate [7-15]

1. Diuretic properties - Theobromine is a diuretic that effectively treats oedema, a condition characterised by fluid buildup in the tissues. By increasing the amount of water that the body excretes via urine, it helps lower blood pressure, which is produced by an increase in the amount of water in fluid-filled connective tissues.
2. Vasodilation - Theobromine improves blood flow and helps lower blood pressure by facilitating greater vasodilation of blood vessels.
3. Improving cardiac functioning - An advantage of theobromine is that it improves cardiac function. The American Journal of Clinical Nutrition reports that theobromine has potential as a treatment for a range of heart conditions, including hypertension, angina, arteriosclerosis, and vascular diseases.
4. Fighting against tooth decay - Because it kills germs that create cavities in mouth, theobromine is an excellent weapon in the fight against tooth decay.
5. Muscle relaxation - Because of its sedative effects, theobromine may calm smooth muscles of heart.
6. Anti-cancer and anti-inflammatory properties - Antioxidants such as flavonoids and polyphenols found in abundance in dark chocolate have anti-inflammatory and anti-cancer effects. These chemicals neutralise free radical

generation, which in turn reduces inflammation and stops unchecked cell proliferation.

7. Prevention of heart disease - One of the best ways to protect yourself against CHD is to eat chocolate, which is packed with minerals like iron, copper, magnesium, zinc, and many more.

8. Reduction of food cravings - Researchers have discovered that dark chocolate may reduce desires for a variety of salty, sweet, and greasy meals due to its bitter flavour, high calorie count, and fat content.

9. Anti-depressant properties - Eating chocolate may help combat sadness by increasing the body's natural supply of feel-good endorphins. Serotonin is another neurotransmitter with antidepressant effects, and chocolates are a great place to get it.

10. Improving memory - By enhancing neurovascular connection in brain's white matter and cognitive performance, drinking hot chocolate improves brain function and memory. Because of its beneficial effects upon brain function, cocoa may help stave against neurodegenerative diseases like Alzheimer's [7-15].

Medicated Chocolates:

For the creation of medicinal chocolates, a chocolate foundation is used, and the medicine is then put into the chocolate to make sure it dissolves and then released. A chocolate medication delivery system describes this approach.

As a result of combining the four taste modalities—salty, sour, bitter—we are able to experience a wide range of "flavours." Not only do children's taste buds vary greatly from adults', but they also have a strong preference for sugary foods.

Significance of Medicated Chocolates

Sidestepping the GIT's presystemic elimination and the liver's first-pass elimination. Hydrolysis is the process by which water-sensitive medications are broken down, making them resistant to microbe growth. Facilitates patient consent, which is particularly well-received by younger patients. Both the local and systemic effects of the medication are shown by its rapid absorption [16].

Method of Preparation

Herbal Drug Extraction (Tulsi)

Process of extraction included gathering young Tulsi leaves from a garden and giving them good washing to get rid of any dust. Next, the leaves were ground into a paste with the use of distilled water and a grinding machine. Decoction technique was used to cook the Tulsi leaf paste with distilled water for 30-45 minutes. It was made sure not to become too hot while this was going on. Then, to get crude extract, the mixture was filtered and the water was evaporated utilising an electric water bath [17-19].

Nutrition in cocoa, carob in chocolate

While vitamins A, B2, and B12 are present in lesser quantities in carob powder, the following vitamins are

abundant: E, D, C, niacin, B6, and folic acid. Oleic, linoleic, palmitic, and stearic acids are among the seventeen found in carob powder oil. Theobromine, energy, salt, potassium, iron, calcium, phosphorus, lipids, sugar, protein, and water are just a few of the nutrients found in cocoa powder. Other nutrients include thiamine, vitamin A, theobromine, phenolics, and cholesterol [20].

Table 01: Formulation Table

Ingredients	Quantity	Uses
Cinnamon	90 mg	Anti-inflammatory, anti-diabetic, antimicrobial, anticancer
Ocimum Sanctum extract	400 mg	Antitussive, Antipyretic, Anti-diabetic, Anti-inflammatory, (30)
Clove	500 mg	Anti-viral, anti-inflammatory, Dental Decay (30)
Sugar	6 g	Sweetening agent
Dark Chocolate	9 g	Antioxidant
Honey	0.05 g	Emulsifier
Cocoa Butter	3 g	Solidifying agent
Vanilla flavor	0.05g	Flavouring agent

Steps to Prepare Medicated Chocolate

1. To make chocolate foundation, measure out all of the ingredients and pass them through a sieve with a mesh size of 30.
2. Make simple syrup by simmering sugar or resistant sugar and water in a beaker for four or five minutes.
3. Add the simple syrup to melted cocoa butter and lecithin in a separate beaker.
4. To make it flow more easily, add cocoa powder or carob powder to the mixture and combine well.
5. Pour the liquid into a polycarbonate mould when it has cooled, then add the flavouring ingredient. Place it in the fridge to harden [21].

Preparation of Medicated Chocolate

1. Get the oven preheated to 50°C so you can melt the chocolate mixture.
2. Combine the melted chocolate foundation with the necessary amount of the medicine and swirl with a magnetic stirrer until well combined.
3. Add the preservatives in the recommended amounts to the mixture.
4. After you've mixed everything together, pour it into a mould and chill it [22].



Evaluation of Chocolate Base [23]

Viscosity Determination of Chocolate Base

Using a Brookfield Rotational Digital Viscometer, we measure the chocolate base's viscosity. Before taking measurements, samples of the chocolate foundation are heated to 50°C and the spindle is turned at a speed of 20 revolutions per minute (rpm). In centipoises (cps), the viscosity values are shown.

Assessing the Qualities of Flavour, Texture, and Mouth Feel

Table 1 shows the results of a taste, texture, and mouth feel evaluation of the chocolate by a panel of ten human participants. The sensory qualities may be subjectively evaluated in this way, yielding useful insights into the chocolate's overall quality and deliciousness. In order to get a qualitative understanding of the customer experience in terms of texture, mouth feel, and taste, the panel's feedback is used [23].

Evaluation of Medicated Chocolates [24]

Organoleptic Properties:-Colour, Odour, Taste, Mouth feel, Appearance (24)

Evaluation Test

1) Chemical Testing:

1) Test for Carbohydrate (Fehling's Test)

One millilitre of Fehling's solution was heated with equal parts of Fehling's solutions A and B. Carbohydrates are present when a brick-red precipitate forms.

2) Test for Protein (Biuret Test/General Test)

The presence of protein is shown by the violet hue, which is achieved by adding 4% NaOH and a few drops of a 1% copper sulphate solution to 3 millilitres of chocolate mixture.

3) Test for amino acids (Ninhydrin test)

3 drops of 5% Ninhydrin were added to 3 millilitres of hot test solution. Boiling water was added to the solution, and it was left to boil for 10 minutes. Amino acid content is indicated by blue or purple colour.

4) Test for Saponins (Foam Formation)

The presence of saponins may be determined by adding 2 millilitres of the chocolate formulation to 2 millilitres of water in a test tube, shaking vigorously until a stable foam forms.

2) pH- A digital pH metre with a glass electrode was used to measure the pH of a solution that included 2 grammes of prepared chocolate dissolved in 100 millilitres of phosphate buffer solution.

General Appearance

The visual identity and general "elegance" of a chocolate formulation are crucial for three reasons: (i) gaining consumer acceptability; (ii) ensuring consistency from batch to batch; and (iii) keeping an eye on trouble-free production. There are a lot of factors that go into controlling a chocolate's overall appearance, including the colour, smell, taste, surface texture, and physical faults.

Dimensions

Vernier calliper is used to measure dimensions of chocolate.

Hardness or crushing strength

The amount of force needed to break the tablet may be found using a Monsanto Hardness Tester or a Pfizer Hardness Tester. As a measurement, kg/cm² is used. To do this, we need to take the hardness of each batch of medicated chocolates, choose a number of them at random, and then get the mean [25].

Moisture content determination

Digital Karl Fischer titrator is used to detect the moisture level of the chocolate formulation. The following formula is used by these devices to determine the water content percentage:

Water = [Volume (mL) TS of water determination consumed x f (mg/mL)/weight of sample (mg)] x 100 (%) Where, f = The number of mg of water (H₂O) corresponding to 1ml of water Determination TS, TS= Water determination test sample [26].

Drug Content Determination

Thin Layer Chromatography was used to ascertain the drug concentration in medicated chocolate. Here, a sample of melted chocolate served as the test, while an aqueous Tulsi extract served as the control. The use of silica gel was used to prepare the TLC plates, which were then activated for half an hour. Utilising capillary techniques, spotting was performed on both the control and test plates. Use a 7:3:2 ratio of toluene to ethyl acetate to water as the mobile phase and run the plates separately. Air drying of the plates was done after both plates were run. Additionally, the iodine chamber was used to see both plates. Drug content in medicated chocolate was found by comparing R_F values of two plates, one for control and one for the test. (27)

Blooming test

Fat Bloom in Chocolate

When a light coating of fat crystals appears on top of the chocolate recipe, it's called fat bloom. The chocolate becomes less shiny and a thin coating of white forms as a consequence of this event; the end result is an unappetising looking confection.

When filler lipids migrate to the chocolate layer or recrystallize, it results in fat bloom. This surface rearrangement of lipid crystals is one cause of the unsightly alterations in the chocolate's appearance.

Preventing fat bloom by keeping chocolate at a consistent temperature is the recommended storage method. By keeping the storage conditions constant, you may reduce the effects of fat bloom, which means the chocolate will retain its attractive appearance and avoid the formation of the unsavoury white layer.

Sugar Bloom in Chocolate

Surface sugar dissolves when chocolate comes into touch with moisture, causing a sugar bloom. Because of condensation, this occurrence causes a rough and uneven coating to form on the chocolate when it is taken out of the fridge. Sugar's unpleasant look is caused by its recrystallization in rough, uneven crystals when the water evaporates, which happens on the surface of the chocolate.

An experiment was conducted on a sample by heating it to 300°C for 11 hours, then cooling it to 180°C for another 11 hours. The test sample was analysed after this heat treatment.

As the water evaporates from the mixture, the sugar that was dissolved in it crystallises and eventually settles to the top of the chocolate. The chocolate covering takes on a dusty look because to the tiny sugar crystals.

Preventing sugar bloom is as simple as keeping chocolate at a constant temperature. The visual attractiveness and texture of the chocolate may be preserved by keeping it in a stable storage environment, which also helps to reduce concerns connected to moisture [28].

In vitro drug Release

Utilising 0.1N HCl as the dissolving medium, the in vitro drug release research of the chocolate formulation is conducted in the USP dissolution equipment Type 1 (Basket). Place 900 ml of 0.1N HCl into the dissolving apparatus vessel and let it heat up to 37±0.5°C while spinning at 50rpm. In the basket goes a chocolate recipe. At regular intervals, the volume is replaced with an equivalent amount of new medium after removing the samples. Filtering and analysis by UV Spectroscopy are performed on the acquired samples [29].

Disintegration test

We tested the disintegration time in 900 ml of 5.8 pH artificial saliva. The experiment was conducted at two different temperatures-37°C and 50°C-without the use of

a disc. The testing procedure included the random selection of six individual chocolates.

We timed the complete disintegration of each chocolate recipe separately, in seconds.

The disintegration behaviour of the chocolates at various temperature circumstances may be better understood with the use of this thorough testing technique, which gives a foundation for evaluating their performance and safety for consumption [26].

Result

1. Viscosity Determination of Chocolate Base: It is determined by Brookfield viscometer and observed to be 560cp viscosity = **0.40kg/ms**
2. Organoleptic Properties:

Table 02: Physical evaluation

Colour	Brown
Odour	Chocolaty
Taste	Sweet
Mouth feel	Smooth and Pleasant
Appearance	Glossy

Average Weight of 5 formulations:
 $W1+W2+W3+W4+W5$

Average weight calculated to be **4.25**
 $+4.05+3.94+4.30+4.255$
 $= 4.15$

3. Chemical Test

Table 03: Chemical evaluations

Name of test	Results
Carbohydrate	+
Protein	+
Amino acid	+
Saponin	-

4. pH-A pH metre was used to measure pH of chocolate formulation, and result was recorded as pH=6.4.
5. **Dimensions** - Length : 4.5 ±0.12 Height 2.5 Thickness: 0.5 Cm
6. **Hardness or crushing strength:**0.2 Kg/cm²
7. **Moisture content determination** he percentage of moisture content = 2.1%
8. **Drug content determination**
9. **Blooming test -**

Table 04: Bloom Test

Name of test	Results
Flat Bloom	No
Sugar Bloom	No

10. In vitro drug Release Disintegration test:

Stability: Test group selected for stability study.

Table 04: Stability test

Parameters	Storage condition	At the time of preparation	After the one month
Colour, Odour, Taste, Mouth feel, Appearance	2-8 °c	Brown, chocolaty, slightly bitter, smooth ,glossy	No change

Conclusion

Creating a herbal multipurpose medicinal chocolate with antitussive, anti-diabetic, anti-inflammatory, and antiviral characteristics was the primary goal of the present study. After meticulously preparing an aqueous extract of Tulsi leaves, a thorough phytochemical investigation verified the presence of the target components. Medicated chocolate was made using this extract and then tested for everything from physical stability to blooming test, drug content, overall appearance, size, and hardness.

According to the results, the chocolate made the mixture feel velvety smooth. Additionally, it effectively disguised the medicine's bad taste, giving it a more appealing choice for consumption. In addition, the medicated chocolate demonstrated therapeutic effectiveness and showed potential as an oral drug delivery mechanism.

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Ethical Statement and Inform Consent

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Author Contribution

All authors are contributed equally.

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