

RESEARCH: CHOCOLATE FORMULATION AS DRUG DELIVERY SYSTEM FOR PEDIATRICS

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<p>*For Correspondence: P.S.G.V.P.M'S College of Pharmacy, Shahada-425409, Dist.-Nandurbar, Maharashtra.</p>	<p>ABSTRACT The primary objective of this study was to formulate and evaluate the nutritious chocolate containing herbal nervine tonics that will have the extra beneficiary learning and memory enhancing effect without any side effects. Hence, in the present investigation an attempt was made to prepare chocolate formulation of <i>Convolvulus pluricaulis</i> and <i>Bacopa monniera</i> which improve the patient's compliances acceptability. The quantitative determination of Bacoside A in <i>Bacopa monniera</i>, scopoletin in <i>Convolvulus pluricaulis</i> and its prepared formulation was developed. The prepared chocolate formulation was evaluated for organoleptic properties, pH, blooming test, preliminary phytochemical screening and hardness. Stability study was performed to see the significant changes observed in the physical properties of chocolate. KEYWORDS: <i>Bacopa monniera</i>, <i>Convolvulus pluricaulis</i>, Bacoside A, Scopoletin, Chocolate.</p>
<p>Received: 09.05.2019 Accepted: 22.12.2019</p>	
<p>Access this article online</p>	
<p>Website: www.drugresearch.in</p>	
<p>Quick Response Code: </p>	

INTRODUCTION

Chocolate is highly sophisticated and much infinitely adaptable foods that can be combined to create completely different taste and consistency sensations. Chocolate is an anhydrous medium resistant to microbial growth and hydrolysis for water sensitive active agents. Chocolate abundantly contains compounds such as saturated fat, polyphenols, sterols, di and triterpenes, aliphatic alcohols, methylxanthines flavones, antioxidants. Cocoa is the main ingredient of chocolate and it is loaded with polyphenols. Chocolate containing the drug in suitable quantity is known as medicated chocolate. Basically there are four types of taste modalities, salty, sour, bitter, sweet through which detect the flavors. Children's taste sensation is much different than adult infants and moreover children have a preference for sweet-tasting substance. Chocolate has been shown to help our body produce a chemical known as Serotonin. It makes one feel relaxed. Further chocolate is also having some advantages like quick onset of action, reduction in the drug dose of manufacture and the combination of these elements we can scale, increases drug loading capacity. Some drugs are bitter in taste due to which oral administration of bitter drugs leads to patient non-compliance especially in children. To overcome this limitation, it is advisable to formulate dosage form which is most acceptable for pediatric patients. Chocolate is one of the most palatable and favorite in children, so we have developed chocolate drug delivery system. ^[1]

Memories are central to our individuality. What each of us remembers is different from what others remember, even of situations we have been in together. Yet, in our distinct ways, all of us remember events, facts, emotional feelings and skills- some for a short time, others for a lifetime [2].

Memory is the ability of individual to record sensory stimuli, events, information, etc. retain them over short or long periods of time and recall the same at later date when needed. Poor memory, lower retention and slow recall are common problems in today's stressful and competitive world. While we all complain about our memories, they are in the most part pretty good, only starting to fail in old age or certain neurological diseases. Age, stress, emotions are conditions that may lead to memory loss, amnesia, anxiety, high blood pressure, dementia, or to more ominous threats like schizophrenia and Alzheimer's disease (AD) [3].

CHOCOLATE

Chocolate can be described as a suspension consisting of nonfat particles (sugar and cocoa solids and, eventually, milk powder particles) dispersed in cocoa butter as a continuous phase. Chocolate is a raw or processed food produced from the seed of the tropical *Theobroma cocoa* tree. The seeds of the cocoa tree have an intense bitter taste, and must be fermented to develop the flavour. After fermentation, the beans are dried, then cleaned, and then roasted, and the shell is removed to produce cocoa nibs. The nibs are then ground to cocoa mass, pure chocolate in rough form. Because this cocoa mass is usually is liquefied then molded with or without other ingredients, it is called chocolate liquor. The liquor also may be processed into two components: cocoa solids and cocoa butter. Unsweetened baking chocolate (bitter chocolate) contains primarily cocoa solids and cocoa butter in varying proportions. Much of the consumed today is in the form of sweet chocolate, combining cocoa solids, cocoa butter or other fat, and sugar. Milk chocolate is sweet chocolate that additionally contain milk powder or condensed milk. White chocolate contains cocoa butter, sugar, and milk but no cocoa solids. Cocoa solids contain alkaloids such as theobromine and phenethylamine, which have physiological effects on the body. It has been linked to serotonin levels in the brain[4].

Chemistry of Chocolate

Phenylethylamine occurs naturally in the brain, and is dubbed the love drug due to its ability to produce feelings of well-being and contentment. It is also present in significant concentrations in chocolate. Tryptophan is a chemical in the brain linked to the production of serotonin, the neurotransmitter that produces feelings of elation. Chocolate also contains Phenylethylamine, a chemical related to amphetamines and raises blood pressure and blood glucose levels. The results are that we feel more alert and gives us a sense of well-being and contentment. It is believed to work by making the brain release b-endorphin, an opioid peptide which is the driving force behind the pleasurable effects. [5]

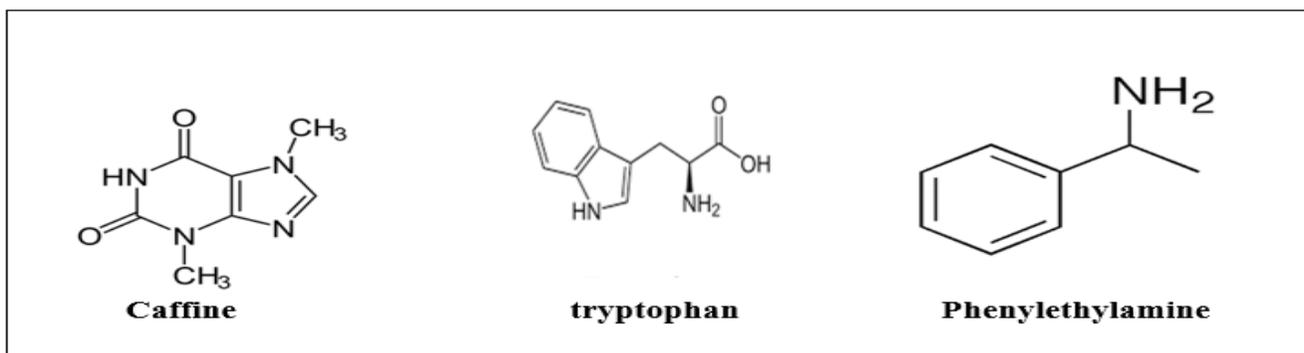


Figure 1.1: Component of chocolate

Cocoa has been reported to be a source of natural antioxidants, the free radicals scavengers that preserve cell membranes, protect DNA, prevent the oxidation of low density lipoprotein (LDL) cholesterol that leads to atherosclerosis and prevent plaque formation in arterial walls. The antioxidant activity of cocoa has been attributed to the procyanidins and their monomeric precursors, epicatechin and catechin, which inhibit oxidation of LDL. Dark chocolate and cocoa inhibit LDL oxidation and increase high-density lipoprotein (HDL) cholesterol concentrations. Catechins are phytochemical compounds found in high concentrations in a variety of plant-based foods and beverages. The catechin content in dark chocolate is 12 mg/100 gm. The epicatechin content in dark chocolate is 41.5 mg/100 gm.

The consumption of catechins has been associated with a variety of beneficial effects including increased plasma antioxidant activity, bronchial artery dilation, fat oxidation and resistance of LDL to oxidation. Epicatechin seems to be a major bioactive constituent of cocoa and other flavonol-rich foods and beverages. It has been shown to improve endothelial function in animals and humans. In salt sensitive animal models of hypertension, epicatechin lowers blood pressure and the associated end organ damage. Nitric oxide seems to play a key role in the protection of both hypertension and endothelial dysfunction. The antioxidant capacity of dark chocolate is 13.1/ 100 g ^[6].

METHOD OF CHOCOLATE PREPARATION

A) Preparation of chocolate base-

The sugar syrup is initially prepared by heating sugar (pharmaceutical grade) and water in a beaker using heating mantle at 50°C for 4-5 minutes. The cocoa base is prepared by melting the cocoa butter in a beaker for 2 minutes and adding the above prepared sugar syrup and cocoa powder to it. This mixture is cooled up to semisolid consistency and adding a flavoring agent.

B) Method of preparation of chocolate-

Oven was set at 50°C. Then prepared chocolate base was melted until it becomes a free owing liquid. After that required quantity of Active pharmaceutical ingredients was added. Then it was stirred well with the help of magnetic stirring for 10 minutes to ensure uniform mixing. Then we poured the above mixture in a polycarbonate set mold and cooled for 15 minutes till it become solid. ^[7]

EXPERIMENTAL METHOD

Extraction of herbal drug

The extraction is done by cold maceration method. First, the powder of Shankhpushpi was macerated with water (100ml) in round bottom flask for 360 hours and powder of Brahmi macerated with mixture of alcohol and Water (70:30) in round bottom flask for 24 hours of occasional shaking. After 24 hours, the solvent was distilled of, the extract was then concentrated on water bath and extract were collected.

Formulation of chocolate

1. All ingredients were weight accurately.
2. In one beaker, cocoa powder and sugar was taken and mixed properly.
3. In another beaker, cocoa butter has melted and this melted butter was added in powder mixture and mixture properly to get fine consistency.
4. After that soya lecithin s an emulsifier was added and mixed.
5. Finally, the herbal drug extract was measured accurately and added in above prepared chocolate.
6. Then vanilla as a flavoring agent was added before going to set in molds.
7. Then the prepared chocolate containing herbal drug extract was poured in molds and kept in freeze to set for overnight.

Formula:

Content	Quantity Given
Cocoa Powder	3.5gm
Cocoa Butter	2.8gm
Sugar	3.6gm
Soya Lecithin	0.05gm
Vanilla	0.05gm
<i>Bacopa</i> Extract	105mg
<i>Convolvulus</i> Extract	106mg

EVALUATION OF CHOCOLATE

Formulation [5, 8, 9]

1. Organoleptic Property

- Colour
- Odour
- Taste

2. Preliminary Phytochemical Screening

- Test for carbohydrate
- Test for protein
- Test for saponins glycoside

3. pH

4. Blooming Test

- Fat blooming
- Sugar blooming

5. Hardness

6. Stability

1) Organoleptic Properties -The general appearance of chocolate formulation, its visual identity and overall elegance is essential.

(i) For consumer acceptance

(ii) For control of lot to lot uniformity

(iii) For monitoring trouble free manufacturing.

The control of general appearance of chocolate involves the measurement of no. of attributes such as chocolates colors, presence or absence of an odor, taste, surface texture and mouth feel.

2) Preliminary Phytochemicals Screening- Preliminary phytochemical screening was performing to detect the presence of organic chemical constituent in chocolate formation. Following organic chemical constituent were screened for detection of its presence or absence in the above mentioned formulations: carbohydrate, protein, amino Acid, fats and oils, steroids, volatile oil, glycoside, flavonoids, alkaloids, tannins and phenolic compound, vitamins, gum and mucilage.

2.1) Test for Carbohydrate (Molichs Test/General Test) - Take 2-3 ml of chocolate formulation, add few drops of alpha- naphthol solutions in alcohol, shake and add conc. Sulphuric acid from the side of test tube, violet ring is a form of at the junction of two liquid indicate the presence of carbohydrate.

2.2) Test for Protein (Biuret Test/General Test)- Take 3ml of chocolate formulation; add 4% NaOH and few drops of 1% copper sulphate solution, violet colour indicate presence of protein.

2.3) Test for Saponins Glycoside (Froth Formation)- Place 2ml of chocolate formulation in water and this was added in test tube, shake well and stable foam is form indicate the presence of saponins glycoside.

3) pH- 2gm of prepared chocolate was dissolved in 100ml of phosphate buffer solution and pH of the resulted solution was studied by digital pH meter with glass electrode.

4) Blooming Test

4.1) Fat Blooms- When a thin layer of fat crystal foams on the surface of chocolate formulation this will cause the chocolate lose its gloss and a soft white layer will appear, giving the finished article an unappetizing look. Fat bloom is caused by the recrystallization of the fats and/or a migration of a filling fat to the chocolate layer storage at a constant temperature will delay the appearance of fat bloom.

4.2) Sugar Bloom- This is a rough and irregular layer on top of chocolate formulation. Sugar bloom is caused by condensation (when the chocolate is taken out of the refrigerator). This moisture will dissolve the sugar in the chocolate. When the water evaporates afterward, the sugar recrystallizes into rough, irregular crystal on the surface. This gives chocolate an unpleasant look. Each sample was subjected to treatment cycles comprised (1) 30 °C for 11 hours, (2) temperature shifting for 1 hour, (3) 18 °C for 11 hours, (4) temperature shifting for 1 hour. A test chocolate formulation observed, after step at 18 °C for 11 hours, whether or not blooming has taken place.

5) Hardness- The hardness of a chocolate or compound coating is an expression of its structure and solidity. Since it is the fat phase of such products that defines the structure it might be expected that the chocolate hardness will be related to the structure and solidity of the fat phase. Firstly, hardness can be defined and calculated from penetrometer measurements. Soeters described this relationship as:

$$H \text{ (kg-cm)} = 15.069 * 100=p \tag{1}$$

Where, p is the penetration in mm/10 (using a 9.18-degree cone with a blunted tip 0.15cm diameter and a total weight of 100g.

6) Stability- The stability studies of formulated formulation were carried out 25/75(°C/RH) and 2-80°C for one month. The chocolate were pack in aluminum foil paper and the organoleptic properties (colour, Odour, taste, mouth feel and appearances) were evaluated for assessing the stability of the prepared formulation.

RESULTS AND DISCUSSION

Evaluation of Chocolate Formulation

1.1 Organoleptic properties (taste, texture and mouth feel characteristics assessment) Taste, texture and mouth feel characteristics of prepared chocolate formulation is show in table-

Parameter	Observation
Color	Brown
Odour	Chocolaty
Taste	Slightly bitter
Mouth feel	Smooth and Pleasant
Appearance	Glossy, even shine, no streaks, dots, cracks

Table 1.1: result of organoleptic properties

1.2 Preliminary phytochemical screening of chocolate formulation

Preliminary phytochemical screening of chocolate formulation as shown in below table.

Phytoconstituent	Bacoside extract	Scopoletin extract	Chocolate formulation
Carbohydrate	Positive	Positive	Positive
Protein	Positive	Positive	Positive
Glycoside	Positive	Positive	Positive

Table 1.2: result of preliminary phytochemical screening

1.3 pH

The ph of chocolate formulation was done by using pH meter and the result was found to be pH= 6.4

1.4 Blooming test

There is no blooming was observed in any formulation.

1.5 Hardness

The Hardness of chocolate formation using Monsanto hardness tester and it was found to be -
Hardness of chocolate formation is 3 kg/cm²

1.6 Stability study

At the end of the month, formulation was tested for organoleptic properties. The result observed are reported in table-

Parameter	Storage condition	At the time of preparation	After the one month
Colour Odour Taste Mouth feel Appearance	28°C (controlled) 25°C	Brown Chocolaty Slight Bitter Smooth and pleasant Even sine, no streaks, dot, cracks	No Change No Change

CONCLUSION

From the above result, it can be concluded that the herbal extract of *Bacopa monniera* and *Convolvulus pluricaulis* were successfully formulated in the chocolate formulation and contain the active constituent i.e. Bacoside and scopoletin used for memory enhancement. The Organoleptic characteristics of chocolate are excellent for masking unpleasant flavors associative with some active agent and imparting a smooth and creamy texture to compositions of active agents. The chocolate formulations provide a palatable means for delivering medicaments through oral delivery. The drug extracts, which are used in the formulation are safe for consumption and can be swallowed without any risk of systemic side effects. The prepared chocolate formulation will be substitute over the preparation available in the market in near future. There much more scope for further investigation and lot of studies are possible as it is a potential drug. It is also preferable to do preclinical and clinical study of the prepared chocolate formulation in future with different learning and memory enhancing models.

ACKNOWLEDGEMENTS

Authors are thankful to Dr. S.P.Pawar principal of P.S.G.V.P.Mandal's College Of Pharmacy Shahada for providing all the facilities and encouragement to carry out the work and also thankful to Lecturers for providing support and knowledge.

REFERENCES

1. V.Vishwanath, B. Narasimharao, *word journal of pharmaceutical research, volume 4, issue 9,842-858.*
2. Alan Baddeley, Learning and Memory Brain Campaign, www.braincampaign.org/Common/Files/2769/echap11.pdf.
3. Vasudevan M and Parle M, Pharmacological actions of *Thespesia populneare* relevant to Alzheimer's disease, *Phytomedicine*, 13, 677-687, 2006.
4. Taubert, Dirk, Renate Rosen, Clara Lehmann, Norma Jung, Edgar Schomig (4 July 2007). Effects of low habitual cocoa intake on blood pressure bioactive nitric oxide. *The Journal of American Medical Association* 298(1): 4960.
5. Sharma Mayank, et.al: (2012), chocolate formulation as a drug delivery system for pediatrics, *Indonesian J. Pharm.* Volume 23, issue 4, 216-224.
6. Geoff Talbot, prediction of hardness of chocolate and compound coating, *Unsilvers Research*, Colworth.
7. *The Ayurvedic Pharmacopoeia of India, Part-II Formulation Vol. II ed. 1st India: Ministry of Health and Family Welfare, Government of India, Department of AYUSH, Page no. 133-254.*
8. Reynolds J, ed. *Martindale, The Extra Pharmacopoeia*, ed.31. London, Eng. Royal Pharm. Society, 1996
9. DerMarderosian A, et. *Natural Product Medicine*, Philadelphia, PA: George F. Stickley Co, 121-22, 140, 313-15, 1988.