FORMULATION AND EVOLUTION OF HERBAL CHOCOLATE FOR PEDIATRICS

Ashwini S. Chikte*1, Komal S. Narwade [2] , Rupesh Lahase[3], Rupalee M. Dhane [4] , Shivshankar M. Nagrik [5], Shirish Jain [6]

[1,2,3] M. Pharm, Department of Quality Assurance, Rajarshi Shahu College of Pharmacy, Buldhana, Maharashtra, India.

[4]Assoc Prof. Department of Quality Assurance, Rajarshi Shahu College of Pharmacy, Buldhana, Maharashtra, India.

[5]M. Pharm, Department of Pharmaceutics, Rajarshi Shahu College of Pharmacy, Buldhana, Maharashtra, India.

[6]Principal, M. Pharm, PhD, Rajarshi Shahu College of Pharmacy, Buldhana, Maharashtra, India.

Abstract

Children's favorite food's chocolate, whereas medicine is a thing they hate, so, the purpose of this study to develop chocolate that included a medicine, I.e., medicated chocolate, in order to prevent disease. In pediatrics cough, and viral infection are the most common diseases. CymbopogonCitratus is herb which is having several medicinal properties such as antimicrobial, antibacterial, activity, etc. Glycyrrhizaglabra Linn. Plant exhibit a broad range of biological properties, including antibacterial, anti-inflammatory, antiviral, antioxidant, and antidiabetic activities. Asparagus racemosus is showgalactogougueeffects, antihepatotoxic, immunomodulatory effects, immunoadjuvant effect, antilithiatic effect and teratogenicity of A. racemosus.Hence, in the present investigation, an attempt was made to prepare a Chocolate formulation of CymbopogonCitratus,glycyrrhizaglabra Linn., asparagus racemosuswhich improves the Pediatric patient's compliance acceptability. Further, preparing Medicated chocolate is evaluated for general appearance, dimension,Hardness, drug content determination, physical stability, etc.

Keywords : Medicated Chocolate, Pediatric , Antibacterial, anti-inflammatory, Antiviral, Cough, Immunomodulatory effects, Glycyrrhizaglabra Linn.

1. INTRODUCTION

Chocolate is adaptable food.[1]It is completely different taste and texture sensations. The Chocolate is resist to microbial growth.[1]The chocolate contain saturated fat, poly phenols Sterols etc.[1] Chocolate is medical important such as it increase HDL cholesterol level and Decrease LDL cholesterol, lessening in hypertension etc.[2]The chocolate is very good way For drug delivery of active drugs.[3] Chocolate contain main ingredient is CocoaChocolate Containing accurate amount of drug in suitable quantity is called as medicated chocolate.[4]The Chocolate having organoleptic characteristics to masking the unpleasant flavour with Some active drugs.[5]The Cocoa is principle of base on chocolate and rich in polyphenols, Catechins etc.[6] Chocolate are semisolid suspension, that fine solid particles from sugar and Cocoa making in fat phase.[7] The most important compound of chocolate is cocoa butter a mixture of different triglycerides solid in below 250C temperature but liquid in body temperature.[8] The herbal chocolate formulation to treatment of cough, immune booster and treatment of malnutrition children.[9] The different form and flavoursof chocolate are produce by different active ingredient.[10] The aim of the present study was to prepare PediatricHerbal Chocolate. Furthermore, to evaluate the Physiochemical parameters of the prepared formulations So that they can be further standardized and used Commercially. [11] Chocolate is adaptable food that can be combined toCreate completely different taste and texture sensations.Also, chocolate is an anhydrous medium that resistMicrobial growth and to hydrolysis of water-sensitive Active agents. Chocolate abundantly contains compounds Such as saturated fat, polyphenols, sterols, di and Triterpenes, aliphatic alcohols, and methylxanthines.[12]Phenyl ethylamine that naturally occurs in the brain and It is termed as ‘the love drug’ which produces the feeling Of well-being and contentment. Phenyl ethylamine also Present in chocolate that raises blood pressure, also blood Sugar level that gives the feeling of wellness.[13] There are Five basic human taste qualities i.e., sweet, sour, bitter,Salty, savory. Sweet taste is one of the most pleasurable Senses. The goal of the sweet taste is to detect the highly Calorific saccharides for ingestion.[14]It is also use for treatment of hormonal imbalance and to increased patient compliance.[11]Medicated Chocolate is prepared by using Chocolate base and the drug is incorporated into The prepared Chocolate based. The drug is incorporated into the Chocolate and the drug is Released from the Chocolate.[15] Chocolate have been shown to help our body produce Chemical known as Serotonin It makes feel Relaxed.[16]The Medicated Chocolate has a morePatient compliance, it more appealing to children Cocoa powder found in vitamin A,Phenolics and all Nutrient etc.[17]The dark Cocoa

butter, lecithin sugar & vanilla.[18]It is best drug delivery system for children.Chocolate having some advantage like quick Onset of action reduced in the drug dose of manufacture etc. Medicated herbal Chocolate is Most acceptable for pediatrics. Chocolate have five basic human taste quality that is sweet, Salty, sour, bitter. Chocolate have five basic human taste quality that is sweet, salty, sour,Bitter.This type of administration of drug delivery is multiple treatment make the patientDue to difficulties to swollen.The chocolate contain lecithin that is natural emulsifier. It is Used in chocolate production to give its best of rheology.The chocolate is medicated Advantages such as lowering blood pressure, change blood flow of the brain, prevention cell Damage & improve the blood glucose level.[18] Chocolate, especially dark chocolate, contains nutrients that can benefit our health when eaten in moderation. It's made from cocoa beans, which have natural compounds like flavonoids and antioxidants that help protect the body and improve overall well-being.

Health Benefits of Chocolate:

Table No.1 Health Benefits of Chocolate

Benefit	How It Helps	Best Type
Heart Health	Lowers blood pressure and improves blood flow	Dark Chocolate
Brain Function	Improves memory, focus, and alertness	Dark Chocolate
Mood Booster	Increases serotonin and endorphins (feel-good chemicals)	All types (best in dark)
Skin Protection	Antioxidant s may help defend against sun damage	Dark Chocolate

Fun Facts About Chocolate and Health

- The Aztecs believed cocoa was a gift from the gods and used cocoa beans as money.
- Dark chocolate (70% cocoa or more) is the healthiest kind.
- Chocolate has a bit of caffeine, giving your brain a small energy boost.
- It can make you feel happy and relaxed by increasing endorphins in the brain.
- Switzerland eats the most chocolate per person in the world![19].

Functional foods and nutraceuticals provide a better option to improve the human health well Being, reduce diseases and support to the rural areas for their all over development. Functional foods and dietary supplements are rapidly growing concept all over the market because the peoples are more aware, their health consciousness due to which their market has been increased. It contains various bioactive compounds that may facilitate to the health-promoting properties of foods items. The consumers are aware of the major role of functional food into diet can play in management of diseases and health care. Bioactive Compounds are the naturally occurring chemical components it contains, or derived from, a plant, animal or marine source, that provide the desired health benefits and well being. Preparations of functional food ingredients are the standardized and its extracts containing bioactive compounds of varying purity forms, which areused as an ingredient for manufacturing in the foods, cosmetics and pharmaceutical sectors also. Nutrients, flavoring materials and dietary supplements are unit major constituents within the nutraceuticals that create them essential in maintaining health, reduce the various disease conditions and thus increase the quality of life [20]. Coconuts have a major role in human diet due to the presence of essential functional components. In coconut fatty acids are present in more amounts that have increasing health beneficial functions. Coconut natural fat in human diet which helps in improving antiinflammatory action on the immune system of human being. It normalizes the body lipids and protects the liver from liver damage. Coconut is a rich source of edible oil and a more amount of extracted coconut used as a frying medium. It is also used in the preparation of chutneys, curries and products formed from shredded coconut, coconut milk, coconut jam, coconut syrup, coconut honey, sweetened condensed coconut milk, etc. In day to day life, coconut have largely used in the preparation of bakery products and many traditional Indian sweets [21]. Coconut based snacks and confectionary products have been largely famous among the people, wherein coconut is the main ingredient. This is made from coconut, sugar, milk, butter and savoring agents. Coconut added confectionary products contribute to high amount of calories and nutrition in the diet provides taste and deliciousness into final product. Fresh coconut meat is rich in protein, lipid, carbohydrate, and other good nutrients. In asparagus the group of steroidal saponins and terpentene saponins are major bioactive constituents. This plant additionally contains vitamins A, B1, B2, C, E, Mg, P, Ca, Fe, and folic acid and other primary chemical components of Asparagus are essential oils, asparagines, arginine, tyrosine, flavonoids (Kaempferol, Quercetin, and rutin), resin, and tannin steroidalglycosides (asparagosides), bitter glycosides, asparagines and flavonoids. The immune system exists to protect you from outside invaders (like bacteria, viruses, fungi, and toxins), as well as your rogue cells that could become

cancerous. Your child is born with innate immunity, which exists in the skin, the cornea of the eye, and the mucous membrane of the respiratory, gastrointestinal, and genitourinary tracts. The innate immune system is constantly on surveillance for potential invaders and immediately responds when they're detected, but its protection is limited, especially early in life[22]. The adaptive immune system kicks in when the innate immune system can't manage a threat. Your child's adaptive immunity (made up of T cells, B cells, and antibodies) develops over time in response to their exposure to different microbes and their chemicals, as well as vaccinations. This arm of the immune system responds more slowly but can target a specific threat. In addition, the adaptive immune system can remember previous threats and respond more quickly to the next exposure. Healthy child immune system development requires repeated exposure to various pathogens, so the innate and adaptive immune systems aren't mature right out of the gate. This leaves kids at higher risk of infection. Fortunately, if your child develops a strong immune system, they often only experience specific infections once, and then they're better prepared. Even when your child has non-symptomatic infections, the immune system is being trained to protect them as they age. Amazingly, 70-80% of immune cells reside in the gut, mainly in the small intestine. Poor gut health equates to altered immune system function, so helping your child build strong immunity requires a focus on the gut and its inhabitants[23].

2.PLANT PROFILE

1. **Lemon grass**

Fig No.1 Lemon Grass

Lemon grass of scientific name is Cymbopogoncitratus. It is word derives from the Greek,The words "kymbe"means boat and "pogon" means beard. The Cymbopogon Citratus are Use in traditional system of medicine and no side effect of allopathic medicine system Lemongrasses plants are the phytochemicals having produced pharmacological effect. It is Known as

citronella grass a member of the Poaceae family and belongs to thegenus Cymbopogon and 140 species throughtout the word.Cymbopogoncitratus fresh leaves are Chemical 0.4% of volatile oil and 65% to 85% citral oil, 12-25% inmyrcene[24].The CymbopogonCitratus are use in traditional system of medicine and no side effect ofAllopathic medicine system lemongrasses plants are the phytochemicals having produced Pharmacological effect. Cymbopogoncitratus is use in soaps, detergents, tea, food Industry, pharmacy industry etc. The lemongrasses are present in main chemical constituents of essential oil like limonene, citral, elemol, citronellal, 1,8 cineole, citronellol, linalool, Geraniol, methylheptenone, b-carophyl, geranylformate and geranyl. Cymbopogon Citratus are pharmacological effect such as analgesic, antipyretic,spasmolytic, tranquilizer,Anti-microbial activity, anti-fungal activity, anti-protozoan activity. Anti-oxidant activity, Anti-diarrhoeal activity, anti-mutagenic activity, anti-Inflammatory activity, anti-malarial Activity. The lemongrass contain 1 to 2% essential oil in dry states. It is chemical of Citral a combination of neral and geranial isomers, which is used as a raw material for the Ionone, vitamin A. Lemongrass is many use in many used in many Thai cuisines. The quality of lemongrass is Depends upon different particle size of chemical contents.The new techniques of Extraction process such as extraction of oil with dense carbondioxide that technique use in Industry. That application biofuel production because higher content essential oil.[25]

Uses of lemongrass plant [26]

- Lemongrass is used for treating digestive tract spasms, cough, and fever.
- It is used for vomiting, abdominal pain and fungal.
- It is also used to the kill the germs and microorganism.
- It is also used as aromatherapy for muscle pain.
- Lemongrass is also used flavouring agent.

2.Liquorice

Glycyrrhizaglabra (Liquorice) has been used in Europe since prehistoric times. It is well documented in written form starting with the Ancient Greeks. Glycyrrhizin is the major active constituent obtained from liquorice roots, one of the most widely used in Herbal preparations for the treatment of liver complaints. The plant is used as anti-inflammatory, spasmolytic, laxative, Anti-depressive, anti-ulcer and anti-diabetic. [27]

Fig No.2 Liquorice

Liquorice grows naturally in different parts of Baluchistan, Chitral and Hindu Kush Himalayan areas. It Roots from Chitral are thick and quality is similar to Chinese liquorice and most suited for commercial Exploitation (Zaidi, 1999Rizvi and Saeed, 2005 Rizvi etal., 2007).The sweeting agent of herbal chocolate-popularly known as “Abhidharma” in Telugu, liquorice is a natural sweetener that enhances the hypoglycaemic effect in diabetic individuals seeking sweetness [28].

Table no.2. Overview of Glycyrrhiza glabra (Licorice)

Category	Details
Botanical Name	Glycyrrhiza glabra
Synonyms	Licoricey, Sweet Root
Plant Characteristics	Herbaceous perennial with compound leaves
Root Characteristics	Thick, fibrous, yellowish-brown on the outside, sweet in taste
Chemical Constituents	**Glycyrrhizin:** Primary sweet-tasting compound **Flavonoids:** Contribute to medicinal properties **Coumarins:** Present in small amounts
Medicinal Uses	• Supports respiratory wellness • Acts as an antioxidant and immunity booster

	• Helps in sore throat, cough (expectorant) • Aids acidity and functions as a mild laxative

3.Shatavari

Fig No.3 Shatavari

Asparagus racemosus A. racemosus) belongs to family Liliaceae and commonly known as Satawar, Satamuli, Satavari found at low altitudes throughout India. The dried roots of the plant are used as drug. The roots are said to be tonic and diuretic and galactgogue, the drug has ulcer healing effect probably via strenthening the mucosal resistance or cytoprotection. It has also been identified as one of the drugs to control the symotoms of AIDS. racemosus has also been successfully by some Ayurveda practitioner for nervous disorder, inflammation and certain infectious disease. However, no scientific proof justify aforementioned uses of root extract of A. racemosus is available so far. Recently few reports are available demonstrating beneficial effects of alcoholic and water extract of the roots of A. racemosus in some clinical conditions and experimentally indused disease eg. Galactogougue affects, anti hepatotoxic, immunomodulatory effects, immunoadjuvant effect, antilithiatic effect and teratogenicity of A. racemosus. The present article includes the detailed exploration of pharmacological properties of the root extract of A. racemosus reported so far.[29]

Uses of shatavari [38]

- BoostsImmuneSystem
- ReducesMoodSwings
- HelpsInIncreasingLactation
- StrengthensFemaleFertility
- NourishesTheOvum

- MayReduceMenstrualCramp
- HelpsInWeightGrowth

Chocolate

It is a complex and adaptable food that may be combined to create a wide range of taste and Consistency sensations. Chocolate is an anhydrous medium for water-sensitive active agentsThat is resistant to microbial growth and hydrolysis. In many ways, chocolate is an excellent Vehicle for delivering active agents. The organoleptic characteristics of chocolate, for Example, are suitable for mask unpalatable flavors associated with some active agents and Delivering a smooth and creamy texture to otherwise unappealingly abrasive active agent Formulations. Saturated fat, polyphones, sterols, Di and triterpenes, aliphatic alcohols, and methylxanthines Are all prevalent in chocolate. Chocolate's main constituent is cocoa, which is high in Polyphones, especially flavan-3-ols like epicatechins, catechins, and procyanidins. A high Intake of dietary flavonoids, a subgroup of polyphenols, may reduce the risk of coronary Heart disease, according to research.[30]

Antioxidants protect cells from free radical damage produced by biological functions like Breathing and external impurities like cigarette smoke. Free radicals cause damage to our Bodies when we don't eat enough antioxidants. Increased oxidation, for example, might cause Plaque to form on the artery walls due to low-density lipoprotein (LDL), generally known as "bad" cholesterol. The sense of flavor perceived in the tongue in contact with a substance" is how taste is Defined. A palatable food or rug is one that has a nice flavor. There are four fundamental Taste modalities: sweet, salty, sour, and bitter. The primary cells for taste are modified Epithelial cells that are organized in taste buds and found in the taste papillae of the tongue. Children's' taste sensations differ from adults' infants, and children have a preference for Sweet-tasting substances that decreases to resemble that of adults by late adolescence. BitterAversion, on the other hand, develops from an early age and, as a response, bitter flavours areMore likely to be unpleasant. Indeed, addition of aversive bettering agents has been proposedAs a method of preventing toxic ingestions in young children.[31]

Chocolate contains lecithin, a well-known natural emulsifier used in chocolate production toGive it its specific rheology. Lecithin is a well-known natural emulsifier that has been used inThe manufacture of micro/ nano emulsions alone or in combination with surfactants toImprove the aqueous solubility of several medications.[32]

Soya lecithin is a kind of phospholipids found in soya beans. It is essentially an industrialWaste product that is recovered from the sludge that remains after the degumming of soya oil.This is why soya lecithin is the most popular type of lecithin on the market; it is a waste Product that can be simply and cheaply obtained from soya bean oil production. Mostly in Liquid form, it shows as a yellow-brownish fatty fluid with a rather thick viscosity. Because Of the polymorphic nature of cocoa butter, it is necessary to temper the chocolate melt during The manufacturing process in order to obtain the best crystal shape, known as Form. Emulsifiers are used to improve the rheological qualities of chocolate formulations. To Reduce the plastic viscosity of the bulk, soya lecithin containing 62 to 70 percent Phospholipids is added. Usually used at a concentration of 0.1 to 0.3 percent, lecithin has a Minimal effect on yield stress. 0.3 to 0.5 percent of the population. While soya lecithin takes Only a few minutes to incorporate, the best time to add it to the chocolate is near the end.[33]

Chocolate also has medical benefits, such as lowering blood pressure, changing blood flow toThe brain, preventing cell damage, and improving glucose levels. It also reduces the risk of Heart attack, improves HDL cholesterol, and lowering LDL cholesterol.However, chocolate has multiple benefits such as a rapid initiation of action, ease of Manufacture and scale, reduced drug dose, and increased drug loading capacity.[34]

CHOCOLATE

Botanical Name: Theobromacacoa

Synonyms: Cocoa tree, Cacao tree

Morphological Characteristics:

Plant:Theobroma cacao is a small evergreen tree that typically grows to a height of 4-8 meters (13-26 feet).

Leaves: The tree has broad, glossy green leaves that are oblong in shape and arranged alternately on the branches.

Flowers: it produces small, delicate flowers directly on the trunk and older branches. These flowers are white to pinkish in colour and have a characteristic odour.

Roots: The roots of the cacao tree are shallow and wide-spreading, helping to anchor the tree in the soil and absorb nutrients and water.[35]

Table no.3. Chemical Constituents of Cacao Beans [36]

Constituent	Description	**Examples**
Flavonoids	Natural compounds with antioxidant properties	Catechins, Epicatechins, Procyanidins, Anthocyanidins
Theobromine	Bitter alkaloid contributing to stimulant effects	Primary stimulant in chocolate
Caffeine	Mild stimulant found in smaller amounts than theobromine	Enhances alertness, complements theobromine
Polyphenols	Antioxidant compounds abundant in dark chocolate	Help combat oxidative stress
Fatty Acids	Present in cocoa butter; contribute to chocolate's smooth texture	Stearic acid, Oleic acid, Palmitic acid
Phenylethylamine	A compound known to elevate mood and enhance feelings of pleasure	Often called the "love drug"
Anandamide	A neurotransmitter that can induce feelings of happiness and relaxation	Referred to as the "bliss molecule"

Types of Chocolates

- Milk chocolate: It is recommended that you use mostly medium roast West AfricanBeans with Ecuadorian beans. This blend would produce a clean, nutty, slightly fruityChocolate. It’s important to remember that the addition of the more acidic Brazilian and Malaysian beans should battle with the desired creamy flavors.[37]
- Light milk chocolate: This product could be prepared with slightly roasted java beans, Which have a light color and a mild overall flavors with strong nutty overtones.
- Because the coating is many shades lighter than a 100 % pure West African bean, this Would aid in obtaining a good standard of identity for milk chocolate.[38]

- High-quality semisweet chocolate: To highlight ideal notes and reduce burnt/bitter Notes, use mostly West African stock (light to medium roast) for its chocolate flavour and Slightly nutty undertones. When mixed with Caracas and Trinidad beans, this blend Produces a balanced yet unique profile with sweet and rather spicy overtones.[39]
- Bittersweet chocolate: this product is mainly designed for use on very sweet and highly Flavored cream centers as it produces very bitter coatings.[40]
- **Semisweet cookie drop:** In order to have a good cocoa impact, it is recommended that The dominating West African beans be used in this product. The Brazilian and Sanchez Components' strong features compliment and contrast the West African component. In this Application, a robust flavor is desirable for contrast in the baked cookies.[41]

Physical properties of chocolate

- Cocoa butter and cocoa powder are the most prevalent forms of chocolate,
- Producing in solid chocolate at room temperature that rapidly melts once inside the Mouth.
- Because of its high melting point, -crystal form is commonly used in the manufacturing Of chocolate.
- A smooth gloss, shine, and snap will come from a consistent crystal structure.
- The crystal form of chocolate is the most stable.
- As the temperature of cocoa butter rises, it transforms into a less stable form that melts Below room temperature.
- In the polymorphic transformation theory of chocolate bloom, the benefits of these Phenomena are used.
- With a pH of 6.8 to 8.1, processed (alkalized) cocoa powder is deeper in colour, ranging From brownish red to almost black[42].

BENEFITS OF CHOCOLATE

Protection from Disease Causing Free Radicals: Free radicals are imbalanced molecules Produced by biological activities in the body, particularly those that battle environmental Contaminants we are exposed to on a regular basis. Antioxidants are substances that areThought to neutralise free radicals and protect the body from their harmful effects. Vitamins, Minerals, and phytochemicals, which are beneficial plant compounds, are all antioxidants. Flavonoids and polyphenols are two types of antioxidants found in dark chocolate. The cocoa In dark chocolatehas been revealed to have the highest concentration of polyphenols and Flavonoids, surpassing even wine and tea. As a result, the higher the cocoa content of yourNext

dark chocolate bar, the more antioxidants you'll get.Potential cancer prevention: It may be difficult to believe, but that delicious dark chocolate You like may also help you avoid cancer. Dark chocolate's potential as a cancer-fighting foodIs one of its many advantages. Role of Dark Chocolate for the treatment of cancer is still Under considerations by researchers.[43]

Improved Heart Health: Flavonol is the most frequent flavonoid found in dark chocolate.According to the Cleveland Clinic, flavonol has a highly good effect on heart health by Lowering blood pressure and boosting blood flow to both the heart and the brain. DarkChocolate flavonol can also assist blood platelets become less sticky and clot-resistant, Lowering the risk of blood clots and stroke. Flavonol improves heart health by reducing blood Pressure and increasing blood flow to both the heart and the brain, according to the Cleveland Clinic. Blood platelets become less sticky and clot-resistant as a result of dark chocolate Flavonol, reducing the risk of blood clots and stroke.[44] Good For Overall Cholesterol Profile: Dark chocolate includes an equal proportion of oleic Acid (a heart-healthy monounsaturated fat also found in olive oil), stearic, and palmitic acids Its cocoa butter. The researchers discovered that just one week of dark chocolateConsumption improved lipid profiles and reduced platelet reactivity in both men and women.[45]

Studies have also shown that:

- Consumption of polyphenol-rich dark chocolate enhanced HDL (good) cholesterol after Three weeks.
- Consumption of polyphenol-rich dark chocolate for 15 days resulted in 6.5 percent and 7.5 percent reductions in total and LDL ("bad") cholesterol, respectively.
- LDL was reduced by 6% after seven days of frequent dark chocolate eating.
- Cholesterol, with an increase of 9% in HDL cholesterol.

Better Cognitive Function: Dark chocolate improve focus and memory in human. Acute as Well as chronic ingestion of flavonol-rich cocoa is associated with enhanced blood flow to Cerebral brain tissue, and it has been proposed that cocoa flavonol might be useful in Disorders with reduced cerebral blood flow. It was also reviewed according that intake of Flavonoid-rich foods, such as chocolate, wine, and tea, shows higher performance across Multiple cognitive functions, and the correlations are dose dependent.[46]

Blood Pressure and Blood Sugar Aid: A 2015 study compared the consumption of white Chocolate by type 2 diabetics to high-cocoa polyphenol-rich dark chocolate by diabetics. For Eight weeks, the participants consumed 25 g (just under one ounce) of black or white Chocolate. Dark chocolate not only reduced hypertensive diabetics' blood pressure, but it also Reduced fasting blood sugar levels, according to the researchers.[47]

Antioxidant-Rich Super Food: Dark chocolate and cocoa powder were compared to super Fruits including acacia, cranberry, blueberry, and pomegranate for total flavonol and Polyphenol content, as well as antioxidant activity. Natural or non-alkalized cocoa has been Used in the study's dark chocolates, cocoa powders, and cocoa liquid. This is significant since Alkalinization of cocoa has been found to eliminate health benefits.[48]

Limitation and caution:

It is necessary for chocolate consumers, especially those who Consume an excessive amount of it, to know that chocolate remains a high-energy meal heavy In calories and sugar.The energy density of each 100 gm of chocolate is 2100 or 500 kcal, Which is enough to contribute to weight gain, which is a risk factor for hypertension, diabetes, And cardiovascular and metabolic disorders in general. The information shown in flavor of Chocolate consumption by this far-reaching study by Cambridge scholars is one of Association, not causation. More research is needed to verify that chocolate actually reduces The risk of heart attacks and strokes. The final seven studies chosen for meta-analysis were all Done in the United States and Europe.As a result, extreme caution should be exercised when Extending the findings to communities in other geographic areas or ethnic groups with Genetic diversity. Applying the findings to other socioeconomic groups should be approached With caution. The findings confirm that the large amount of heterogeneity in the data they had To work with prevented them from estimating a dose response relationship between the Amount of chocolate consumed and the degree of risk reduction in cardiovascular and Metabolic outcomes in quantitative terms. The idea of creating a dose-response relationship In the feature, among other possibilities for examination that the field opens up, is an Appealing research goal that can go a long way toward cementing chocolate's place as a meal That can provide dose-dependent positive effects.[49]

Medicated Chocolates:

Medicated chocolates are made with a chocolate base and the drug is poured in so that the Drug is incorporated into the chocolate and released from the chocolate. This is called to as a Chocolate drug delivery system.There are four types of taste modalities, salty, sour, bitter,

through the combination of these Elements we can detect the “flavors” Childrens’ tastes sensation is much differed than adult Infants and more over children prefer sweet-tasting substance.[50]

Advantages

Chocolate has been demonstrated to stimulate in the synthesis of a substance known as “serotonin” in our bodies.

- It makes feel relaxed.
- Quick onset of action,
- Reduction in the drug dose of manufacture and scale,
- Increases drug loading capacity.

When some remedies have a bitter taste, oral delivery of bitter drugs causes patient Noncompliance, especially in children. To solve this problem, a dose form that is most Appropriate to pediatrics patients must be developed.[51]

3. MATERIALS AND METHODS

3.1 Materials

- **1.Cocoa powder:-**

Fig No. 4 Cocoa powder

Cocoa, a product derived from the beans of the TheobromaCocoa plant, has been consumed since 600 BC, first by ancientCivilisations, such as the Mayans and Aztecs. Cocoa consumption in Europe dates from the 16th century whenHerna´n Corte´s introduced it to the Iberian Peninsula; fromThere its use spread rapidly to Western Europe.CocoaPowder is a rich source of fibre (26–40 %), proteins (15–20 %), carbohydrates (about 15 %) and lipids (10–24 %;Most, 10 –12 %), and it contains minerals (for example, Ca,Mg, K) and vitamins (A, E, B and folic

acid) (Table 1).Cocoa has become a subject of increasing interest becauseOf its high content of polyphenolic antioxidants, particularlyFlavonoids. Cocoa powder is reported to contain up to 70 mgPolyphenols/g (expressed as catechin). A serving size portion of certain cocoa-derived products provides more phenolicAntioxidants than beverages and fruits such as tea and blueberries, traditionally considered high in antioxidants.[52] CocoaMainly contains the monomers (2)-epicatechin and catechin,And various polymers derived from these monomers, knownAs procyanidins . Monomer content rangesFrom 0·20 to 3·50 mg/g, depending on the type of product,With epicatechin content being higher than (þ)-catechin inMost cocoa products.Procyanidins are the major flavonoids in cocoa and chocolate products, with reported levelsRanging from 2·16 to 48·70 mg/g(6). MethylxanthinesHave also been identified in cocoa powder, and account for0·5– 2 % of the DM[53].

Table 4. Cocoa powder: nutritional information per 100g [54]

Nutrients	Contentper100mg
• Macronutrients 1. Energy	200kcal
2. Proteins	21g
3. Carbohydrates	16g
4. Starch	13g
5. Lipids • Saturated • Monounsaturated • Polyunsaturated	10.4g 6.5g 3.6g 0.3g
6. Fibres	32.7g
• Micronutrients	
7. Sodium	0.02g
8. Potassium	4.2g
9. Calcium	150mg
10. Phosphorus	700mg
11. Ferrus	25mg
12. Magnesium	550mg
13. Zinc	7mg
14. Copper	4mg

15. Vitamin A(Retinol)	0.2mg
16. Vitamin (Etocopherol)	<2.4mg
17. Vitamin B1	0.2mg
18. Vitamin B2	0.4mg
19. Niacin	0.6mg

2.Cocoa Butter

Fig No. 5 Cocoa Butter

Cocoa butter (CB) is the byproduct of cocoa bean processing Industry and is obtained from the mature bean from the Theobroma cacaoPlant. It is an important ingredient in the chocolate and other confectionery Industries. It's valued for its unique physicochemical properties which is Given by its peculiar fatty acid composition. The major triacylglycerols(TAG) present in CB is symmetrical and contains very less amount of Highly unsaturated fatty acid. The major fatty acids present in it are palmitic Acid, stearic acid, oleic acid and linoleic acid, but low amounts of lauric Acid and myristic acid. Increasing demand and shortage of supply for CB, Poor quality of individual harvests, economic advantages and some Technological benefits have induce for the development of its alternative Called cocoa butter replacer (CBR). [55]

Cocoa butter is obtained By pressing of mature cocoa beans. CB is a valuableByproduct of the cocoa industry. It is a pale yellow Liquid with a characteristic odor and the flavor ofChocolate. It is an important and the only continuous fat Phase found in chocolate, which help in the dispersion Of the other ingredients also (Wang et al., 2006). It isBrittle at temperature below 25○C, soften in the hand And melts in the mouth having at a temperature of About 34C.This specific physio-chemical properties Makes it is an important ingredient in confectionery Industry. It is not greasy to touch. Cocoa butter Contains a high proportion of saturated fat, derived From starch and palmitic acid and contains trace amounts of caffeine and theobromine.

It also contains Fat soluble antioxidants such as vitamin E in the form Of β-tocopherol, α-tocopherol and γ-tocopherol helps inIts storage by increasing its therapeutic properties. [56]

3.soya lecithin

Fig No.6 Soya Lecithin

Lecithin has long been an important component of a myriad of both food and non-food products and is one of the most versatile and valuable byproducts of the oilseed industry. In foods, lecithin provides about a dozen functions, including as an emulsifier, as a wetting agent, for viscosity reduction, as release agents, and for crystallization control. Lecithin also provides functions in numerous industrial applications as well. By 1940, the U.S. lecithin industry was well established. The lecithin industry is a mature one, but several factors have affected it.Although historically soybean has been the major source of lecithin worldwide, others are being sought because of increased demands for non-Genetically Modified Organism (GMO) lecithin, including canola and sunflower. Although lecithin from GMO soybeans has been shown to be equivalent to non-GMO lines, the European market prefers non-GMO lecithin. Over the past few decades, lecithin has become more important as a neutraceutical and food supplement ingredient. Moreover, the discovery of liposomes has provided a new and more efficient means for drug delivery. This chapter reviews the lecithin industry, manufacture and properties of commercial products, their quality control and modification, and food and nonfood uses.[57]

3.2 METHODS

Method of extraction by decoction[58]

Extraction of lemongrass:-

The dry lemongrass leave were collected garden and wash with water. The dry leaves were crush with help of grinding machine. Further to take a 40gm of Lemongrass powder and added 700ml of distilled water.

Fig. No. 7 Lemongrass extraction method

The lemongrass leave powder boil with distilled water. Then up to ¼ water quantity reduce For the 1 to 2 hour that is decoction method. The extra care should taken avoid the excess of Heating

Excess water present in extract were removed by evaporating heating mantle instrument. After evaporation process to kept it few 2 to 3 day in room, for naturally evaporation. It will Form sticky and reddish colours of lemongrass extract. [59]

Formulation of herbal chocolate[60]

Table No.5: Formulation Table.

Sr. No.	Ingredients			
		Batch A	Batch B	Batch C
1.	Cocoapowder	6gm	7.23gm	6.7gm
2.	Cocoa butter	550mg	390mg	590mg
3.	Soya lecithin	280mg	430mg	738mg
4.	Coconut sugar	270mg	373mg	373mg
5.	Milk	350mg	379mg	389mg
6.	Lemongrass extract	450mg	302mg	350mg
7.	Liquorice powder	100mg	50mg	60mg
8.	Shatavari powder	2gm	846mg	800mg

METHOD OF PREPARATION [61]

All the ingredients are weighed accurately

In a beaker, sugar and milk is taken and sugar syrup is prepared on heating mantle.

Cocoa butter is heated in a separate beaker, then the melt butter is poured into powder Mixture and thoroughly combined to get a fine consistency.

After that soya lecithin is added and mixed well.

Finally the drug or API(lemongrass extract,liquorice powder, shatavari powder) is added in prepared chocolate base.

Then the flavoring agent (lemongrass extract)is added before going to set in moulds and kept in room temperature .

Poured the Chocolate mould was refrigerated upto the 6 to 7 hours, till whole Chocolate Mass completely solidified nature.

3.3 Evaluation of herbal cholate [62]

- Preliminary Phytochemical screening
- General appearance
- Hardness
- Dimension
- Physical stability
- Drug content determination
- Blooming test

1.Preliminary Phytochemical screening

Following organic chemical constituent screened for presence or absence formulation such asCarbohydrate, protein, amino Acid, fats, glycoside, vitamins, phenolic compound, alkaloids, Flavonoids etc.

1.1 Test for carbohydrate (fehling's test): Take a 5ml fehling solution was added 0.5mg ofExtract and boiling water bath. To form of yellow or red precipitate. To indicate presence of Carbohydrate.[63]

1.2 Test for alkaloids (wagner's test): The take few drops of wagner solution added in a 10mg of extract to formation of reddish brown precipitated. To indicate that presence Alkaloids. [64]

1.3 Test for flavonoids (lead acetate test): few drops of lead acetate solution added in 10mg Of lemongrass extract. To formation of yellow colour precipitated. To indicate that presenceOf flavonoids.

1.4 Test for phenols and tannins (lead acetate test): To taken 10mg of extract and added in A 0.5ml of 1% lead acetate solution. To form precipitated indicate that phenols and tanninsPresence.

1.5 Test for saponins (foam test): To take a 20ml of distilled water added 0.5ml extract with A shaken well in a graduated cylinder for a 15min. The form of foam to length of 1cm.Foam is formed it indicates presence of saponins[65]

1.6 Test for steroids and sterols (salkowski's test): The 2ml of chloroform solution Dissolved in 5mg extract. Then equal volume of concentrated sulphuric acid was added side Of the test tube. Upper layer is red and lower layer is yellow with green.

1.7 Test for glycosides: Take a 1ml of water added was 0.5mg of leave extract. Then added Aqueous NaOH solution to form yellow colour. Test protein & amino acids (ninhydrin test): To drops of freshly prepared ninhydrin Reagent was added 0.5mg extract and heated. To formation of pink colour.[66]

2.General appearance[67]

Tablet No.6. General appearance

Colour	**Dark Brown**
Order	**Chocolaty**
Test	**Slight sweet**
Texture	**Smooth and even**
Appearance	**Glossy, even shine**

3.Dimension[68]

Dimension was measured by the vernier's calipers. The veniers calipers to adjust first then Used it was remove error. Then to note down the reading of chocolate.

4. Hardness[69]

The Monsanto hardness tester was used by the measure of hardness of Chocolate. Chocolate Is tied with upper part of Monsanto hardness tester. Then adjust the movable scale zero Marking. The pressure create by hand on Monsanto tester handle up to the breaking of Chocolate. Then noted the reading.

5. Physical stability[70]

To determine physical stability of the medicated Chocolate. It is kept in a closely tide Container for a 1 month at 200C temperature. After 1 month, to observe test sample of Physical appearance for medicated Chocolate.

6. Drug content determination[71]

The medicated Chocolate of drug content was measured by using thin layer chromatography Techniques. The lemongrass extract is control and the melted medicated Chocolate as test. ToPrepared thin layer chromatography plate by silica gel. The silica gel powder was added Appropriate quantity of distilled water to formation of slurry. The slurry pour into the slide With the help of dropper and the plate was kept in hot air oven at 1 ½ hour. Then spotting was Carried out both plate. To prepared mobile phase by using ethyl acetate : ether. That is ratio 3:1. The both the plate kept in mobile phase 5 to 10 min. After running both plate air drying. The fully dry plate was kept in iodine chamber to identified the visualization of spots. The Rf Value determine for a compared by the both plate. The determine the medicated Chocolate Was determine.

7. Blooming test[72]

Fat Bloom – When the thin layer of fat crystals form on The surface of chocolate formulation. This will cause the Chocolate to 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 fat or a migration of a filling fat to the chocolate layer. Storage At a constant temperature will delay the appearance of fat Bloom.

Sugar Bloom –This is rough and irregular layer on top Of chocolate formulation. This is caused by condensation(when chocolate is taken out of the refrigerator). This Moisture will dissolve the sugar in the chocolate. When The water evaporates, sugar recrystallizes into rough, Irregular crystals on surface. This results into unpleasant Look.Test sample of chocolate was

subjected to treatmentCycles contains.30 ℃ for 11 hoursShifting of temperature for 1 hour18 ℃ for 11 hoursShifting of temperature for 1 hour Observed the test sample of chocolate whether blooming Has taken place.

4. RESULT AND DISCUSSION

Tablet No7.Preliminary Phytochemical screening Result

Sr. No.	Test of extract	Observation	Indication
1.	Test for alkaloids (Wagner's test)	Reddish brown	Present
2.	Test for flavonoids (Shinoda test)	Yellow ppt	Present
3.	Test for phenols and tannis (Lead acetate test)	Precipitates form	Present
4.	Test for carbohydrates (Fehling test)	Yellow ppt	Present
5.	Test for saponins (Foam test)	Foam form	Present
6.	Test for steroids (salkowsaki's test)	No red colour	Absent
7.	Test for glycosides	No yellow	Absent
8.	Test for protein (Ninhydrin test)	No pink	Absent

Fig No.5 Preliminary Phytochemical screening Result

Fig.8. Preliminary Phytochemical screening

EVALUATION TEST OF CHOCOLATE

Tablet No 8.General appearance

Batch	**A**	**B**	**C**
Colour	Brown	Dark brown	Brown
Odour	Chocolaty	Chocolaty	Chocolaty
Test	Sweet	Sweet	Sweet
Texture	Rough	Smooth	Smooth
Appearance	Dull	Glossy	Glossy

3.Dimension test: The measured by Vernier's callipers.

Fig No. 9 Vernier's calipers(Dimension test)

Table No.9 Dimension test Of Chocolate

	Batch A	**Batch B**	**Batch C**
Height	2.67	2.65	2.65
Diameter	2.94	2.96	2.95

4.Hardness test

Table No.10 Hardness test Of Chocolate

Sr No.	Temperature of Chocolate	Indication
1.	28ºC of Chocolate	2.5 kg/cm2
2.	Room Temperature	1.5 kg/cm²

5.Physical stability

Fig No.10 Monsanto hardness apparatus

Fig No. 11 Preparation of herbal chocolate

Batch A

Batch B

Batch C

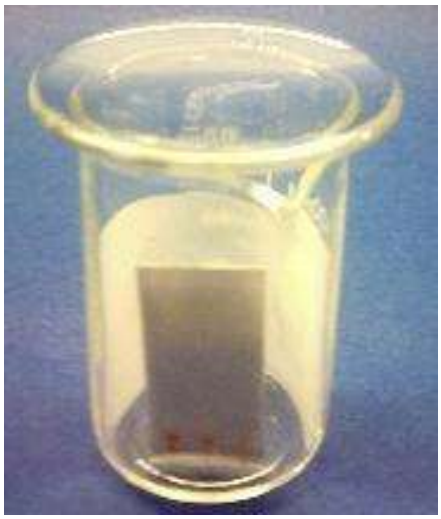
Batch A (instability because of excessive water)

The physical stability ofbatch -A after 1month was unstable because excessive moisture content. The Physical stability of batch -B after 1 month was unstable because of excessive sugar. The Physical stability of batch -C after 1 month was good appearance.

6.Drug content determination

'A'

'B'



'C'

'D'

- Distance travelling by the solvent of the control :- 6.8 cm
- Distance travelling by the solute of the control :- 1.5 cm
- Distance travelling by the solvent of the test : - 6.7 cm
- Distance travelling by the solute of the test : - 1.6 cm
- Rf value = Distance travelling by solute control
- Distance travelling by solvent control
- Rf value of control = 0.22

- Rf value of test = 0.23

7. Blooming test

Table No.11 Blooming test

Test	Batch A	Batch B	Batch C
Fat Bloom	Yes	No	No
Sugar Bloom	No	Yes	No

5. CONCLUSION

The development of herbal chocolate incorporating Lemongrass (Cymbopogoncitratus), Liquorice (Glycyrrhizaglabra), and Shatavari (Asparagus racemosus) provides a novel and effective approach to promoting pediatric health through natural means. Each of these herbs offers unique therapeutic benefits: Lemongrass contributes antimicrobial and digestive properties, Liquorice offers soothing and immune-boosting effects, while Shatavari supports growth, immunity, and overall nourishment. By combining these herbs in a chocolate base, the formulation becomes more palatable and appealing to children, ensuring better compliance compared to conventional herbal remedies. This project demonstrates that herbal chocolates can serve as a functional, safe, and child-friendly alternative for delivering traditional medicinal benefits. Further studies focusing on taste optimization, stability, and dosage standardization are recommended to enhance its potential for real-world pediatric healthcare applications The incorporation of lemongrass (Cymbopogoncitratus) into pediatric herbal chocolate presents a promising natural alternative for enhancing children's health through a palatable and enjoyable medium. Lemongrass, known for its antimicrobial, antioxidant, and digestive properties, can be effectively combined with chocolate to create a functional treat that not only appeals to children's taste preferences but also provides therapeutic benefits. Preliminary results indicate that this formulation is well-accepted in terms of taste and texture, while also potentially supporting immunity and digestion in children. Further clinical evaluation and safety assessments are recommended to confirm long-term benefits and optimal dosage for pediatric use The development of herbal chocolate Incorporating liquorice (Glycyrrhizaglabra) presents a promising, child-friendly approach to delivering natural therapeutic benefits. Liquorice is known for its anti-inflammatory, antimicrobial, and immune-

boosting properties, making it especially suitable for pediatric use. By combining the health benefits of liquorice with the palatability of chocolate, this formulation addresses both efficacy and acceptance among children. The product offers potential for improving respiratory health, soothing sore throats, and enhancing overall immunity in a natural and enjoyable form. Further studies on dosage standardization, long-term effects, and flavor optimization will help in advancing this formulation toward commercial pediatric use. Formulating herbal chocolate with Shatavari (Asparagus racemosus) offers a novel and child-friendly method to support pediatric health. Known for its adaptogenic, immunomodulatory, and nutritive properties, Shatavari is especially beneficial for enhancing growth, digestion, and immunity in children. By integrating it into a chocolate base, the therapeutic benefits are delivered in a tasty and appealing form, improving compliance and acceptance among young patients. This innovative approach not only preserves the medicinal value of Shatavari but also makes it enjoyable for children, promoting wellness through a natural and holistic medium. Further clinical evaluation will support its safety, efficacy, and potential for routine pediatric use.

REFERENCES

1. Shaikh H, Koli P, Undale V, Pardeshi A, Asalkar M, Sahastrabuddhe S, Kawade A, Upasani C. Safety and protective effects of influenza vaccination in pregnant women on pregnancy and birth outcomes in Pune, India: a cross-sectional study. Vaccines. 2023 May 28;11(6):1034.
2. Sathe MV, Shah RR. FORMULATION AND EVALUATION OF PEDIATRIC HERBAL CHOCO
3. Pawar PD, Bakliwal AA, Talele SG, Jadhav AG. Formulation and evaluation of herbal chocolate as nervine tonic. Journal of Pharmaceutical Sciences and Research. 2019 May 1;11(5):1808-13.
4. Viswanath V, Narasimharao B, Purushothaman M, Sireesha S. Formulation and evaluation of fexofenadine hydrochloride and paracetamol chocolate for pediatrics. heart disease. 2015 Jun 19;3:5.
5. Egan BM, Laken MA, Donovan JL, Woolson RF. Does dark chocolate have a role in the prevention and management of hypertension? Commentary on the evidence. Hypertension. 2010 Jun 1;55(6):1289-95.
6. Shah G, Shri R, Panchal V, Sharma N, Singh B, Mann AS. Scientific basis for the therapeutic use of Cymbopogon citratus, stapf (Lemon grass). Journal of advanced pharmaceutical technology & research. 2011 Jan 1;2(1):3-8.

7. Ohadinia S, Jamshidi A, Khani M, Jamshidi AH, Khani M. Complex Antimicrobial Interactions of Essential Oils–The Case of Thymus vulgaris (thyme). Molecules 2014; 19: 2896–2910 [7] Ahmad A, Viljoen A, Chenia HY. The impact of plant volatiles on bacterial quorum sensing. Lett Appl. Health Med. 2003;9:58-61.
8. Zhao J, Fan Y, Cheng Z, Kennelly EJ, Long C. Ethnobotanical uses, phytochemistry and bioactivities of Cymbopogon plants: A review. Journal of Ethnopharmacology. 2024 Apr 10:118181.
9. Bassolé IH, Lamien-Meda A, Bayala BO, Obame LC, Ilboudo AJ, Franz C, Novak J, Nebié RC, Dicko MH. Chemical composition and antimicrobial activity of Cymbopogon citratus and Cymbopogon giganteus essential oils alone and in combination. Phytomedicine. 2011 Sep 15;18(12):1070-4.
10. Ranade SS, Thiagarajan P. Lemon grass. Int. J. Pharm. Sci. Rev. Res. 2015;35(2):162-7.
11. Bopana N, Saxena S. Asparagus racemosus—Ethnopharmacological evaluation and conservation needs. Journal of ethnopharmacology. 2007 Mar 1;110(1):1-5.
12. Mi XJ, Xu XY, Choi HS, Kim H, Cho IH, Yi TH, Kim YJ. The immune-enhancing properties of hwanglyeonhaedok-tang-mediated biosynthesized gold nanoparticles in macrophages and splenocytes. International Journal of Nanomedicine. 2022 Jan 29:477-94.
13. Arora R, Gupta D, Chawla R, Sagar R, Sharma A, Kumar R, Prasad J, Singh S, Samanta N, Sharma RK. Radioprotection by plant products: present status and future prospects. Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives. 2005 Jan;19(1):1-22.
14. Patel J, Joshi M, Thakkar V, Gohel M, Baldaniya L, Patel A. Medicated chocolate containing cefpodoxime proxetil: a novel solid dosage form for paediatric patient. InProceedings of RK University's First International Conference on Research & Entrepreneurship (Jan. 5th & Jan. 6th, 2016) 2016.
15. Mayank S, Kumar JD. Chocolate formulation as drug delivery system for pediatrics. Indonesian Journal of Pharmacy. 2012 Oct 1;23(4):216-24.
16. Viswanath V, Narasimharao B, Purushothaman M, Sireesha S. Formulation and evaluation of fexofenadine hydrochloride and paracetamol chocolate for pediatrics. heart disease. 2015 Jun 19;3:5.
17. Naqvi RF, Khan A, Umer MF, Malik O, Shahwani NA. Design and optimization of novel taste-masked medicated chocolates of dextromethorphan with in vitro and in vivo taste evaluation. Journal of Pharmaceutical

18. Pawar PD, Bakliwal AA, Talele SG, Jadhav AG. Formulation and evaluation of herbal chocolate as nervine tonic. Journal of Pharmaceutical Sciences and Research. 2019 May 1;11(5):1808-13.
19. Vasani C, Shah K. Preparation and evaluation of chocolate drug delivery system of albendazole. Research journal of pharmacy and technology. 2016 Nov 1;9(11):1994.
20. Latif R. Chocolate/cocoa and human health: a review. Neth J Med. 2013 Mar 1;71(2):63-8.
21. Patel N, Diwan S, Shukla K, Tomar P, Jain H, Pradhan P, Upadhyay U. Chocolate drug delivery system: a review. Indo American journal of pharmaceutical sciences. 2015 Jun 1;2(6):1077-81.
22. Pawar PG, Darekar AB, Saudagar RB. Medicated chocolate, and lollipops: a novel drug delivery system for pediatric patient. Pharma Science Monitor. 2018 Jan 1;9(1):677-96.
23. Ackar D, Valek Lendić K, Valek M, Šubarić D, Miličević B, Babić J, Nedić I. Cocoa polyphenols: Can we consider cocoa and chocolate as potential functional food?. Journal of chemistry. 2013;2013(1):289392.
24. Haritha K, Kalyani L, Rao AL. Health benefits of dark chocolate. Journal of advanced drug delivery. 2014;1(4):184-95.
25. Sunil R, Mounika K, Shalini S, Venkatesham A. Design and fabrication of medicated chocolate formulation by chocolate drug delivery system. Journal of Current Pharma Research. 2016 Oct 1;7(1):2010-20.
26. Wollgast J, Anklam E. Polyphenols in chocolate: is there a contribution to human health?. Food Research International. 2000 Jul 1;33(6):449-59.
27. Katz DL, Doughty K, Ali A. Cocoa and chocolate in human health and disease. Antioxidants & redox signaling. 2011 Nov 15;15(10):2779-811.
28. Steinberg FM, Bearden MM, Keen CL. Cocoa and chocolate flavonoids: implications for cardiovascular health. Journal of the American dietetic association. 2003 Feb 1;103(2):215-23.
29. Ramiro-Puig E, Castell M. Cocoa: antioxidant and immunomodulator. British Journal of Nutrition. 2009 Jan;101(7):931-40.
30. Dhama K, Sachan S, Khandia R, Munjal A, MN Iqbal H, K. Latheef S, Karthik K, A. Samad H, Tiwari R, Dadar M. Medicinal and beneficial health applications of Tinospora cordifolia (Guduchi): a miraculous herb countering various diseases/disorders and its immunomodulatory effects. Recent patents on endocrine, metabolic & immune drug discovery. 2016 Aug 1;10(2):96-111.

31. Katz DL, Doughty K, Ali A. Cocoa and chocolate in human health and disease. Antioxidants & redox signaling. 2011 Nov 15;15(10):2779-811.
32. Steinberg FM, Bearden MM, Keen CL. Cocoa and chocolate flavonoids: implications for cardiovascular health. Journal of the American dietetic association. 2003 Feb 1;103(2):215-23.
33. Grassi D, Desideri G, Ferri C. Protective effects of dark chocolate on endothelial function and diabetes. Current Opinion in Clinical Nutrition & Metabolic Care. 2013 Nov 1;16(6):662-8.
34. Martin FP, Rezzi S, Peré-Trepat E, Kamlage B, Collino S, Leibold E, Kastler J, Rein D, Fay LB, Kochhar S. Metabolic effects of dark chocolate consumption on energy, gut microbiota, and stress-related metabolism in free-living subjects. Journal of proteome research. 2009 Dec 4;8(12):5568-79.
35. Loke YH, Jayakrishnan A, Razif MR, Yee KM, Kee PE, Goh BH, Uddin AH, Lakshminarayanan V, Liew KB. A Comprehensive Review of Challenges in OralDrugDeliverySystems and RecentAdvancements in Innovative Design Strategies. Current Pharmaceutical Design. 2024 Oct 10.
36. Karalia D, Siamidi A, Karalis V, Vlachou M. 3D-Printed oral dosage forms: Mechanical properties, computational approaches and applications. Pharmaceutics. 2021 Sep 3;13(9):1401.
37. Dhakate CS, Upadhye KP, Dixit GR, Bakhale SS, Umate RM. Taste masking by co-crystallization: A review. World J Pharm Res. 2017 May 18;6:1531-48.
38. Hurst WJ, Tarka Jr SM, Powis TG, Valdez Jr F, Hester TR. Cacao usage by the earliest Maya civilization. Nature. 2002 Jul 18;418(6895):289-90.
39. Dillinger TL, Barriga P, Escárcega S, Jimenez M, Lowe DS, Grivetti LE. Food of the gods: cure for humanity? A cultural history of the medicinal and ritual use of chocolate. The Journal of nutrition. 2000 Aug 1;130(8):2057S-72S.
40. Vinson JA, Proch J, Zubik L. Phenol antioxidant quantity and quality in foods: cocoa, dark chocolate, and milk chocolate. Journal of Agricultural and Food Chemistry. 1999 Dec 20;47(12):4821-4.
41. Lee KW, Kim YJ, Lee HJ, Lee CY. Cocoa has more phenolic phytochemicals and a higher antioxidant capacity than teas and red wine. Journal of agricultural and food chemistry. 2003 Dec 3;51(25):7292-5.
42. Vinson JA, Proch J, Bose P, Muchler S, Taffera P, Shuta D, Samman N, Agbor GA. Chocolate is a powerful ex vivo and in vivo antioxidant, an antiatherosclerotic agent in an

animal model, and a significant contributor to antioxidants in the European and American diets. Journal of Agricultural and Food Chemistry. 2006 Oct 18;54(21):8071-6.

43. Gu L, House SE, Wu X, Ou B, Prior RL. Procyanidin and catechin contents and antioxidant capacity of cocoa and chocolate products. Journal of agricultural and food chemistry. 2006 May 31;54(11):4057-61.
44. Pura Naik J. Improved high-performance liquid chromatography method to determine theobromine and caffeine in cocoa and cocoa products. Journal of agricultural and food chemistry. 2001 Aug 20;49(8):3579-83.
45. Hackman RM, Polagruto JA, Zhu QY, Sun B, Fujii H, Keen CL. Flavanols: Digestion, absorption and bioactivity. Phytochemistry Reviews. 2008 Jan;7:195-208.
46. Rios LY, Bennett RN, Lazarus SA, Rémésy C, Scalbert A, Williamson G. Cocoa procyanidins are stable during gastric transit in humans. The American journal of clinical nutrition. 2002 Nov 1;76(5):1106-10.
47. Baba S, Osakabe N, Yasuda A, Natsume M, Takizawa T, Nakamura T, Terao J. Bioavailability of (-)-epicatechin upon intake of chocolate and cocoa in human volunteers. Free radical research. 2000 Jan 1;33(5):635-41.
48. Deprez S, Mila I, Huneau JF, Tome D, Scalbert A. Transport of proanthocyanidin dimer, trimer, and polymer across monolayers of human intestinal epithelial Caco-2 cells. Antioxidants and redox signaling. 2001 Dec 1;3(6):957-67.
49. Holt RR, Lazarus SA, Sullards MC, Zhu QY, Schramm DD, Hammerstone JF, Fraga CG, Schmitz HH, Keen CL. Procyanidin dimer B2 [epicatechin-(4β-8)-epicatechin] in human plasma after the consumption of a flavanol-rich cocoa. The American journal of clinical nutrition. 2002 Oct 1;76(4):798-804.
50. Tsang C, Auger C, Mullen W, Bornet A, Rouanet JM, Crozier A, Teissedre PL. The absorption, metabolism and excretion of flavan-3-ols and procyanidins following the ingestion of a grape seed extract by rats. British Journal of Nutrition. 2005 Aug;94(2):170-81.
51. Baba S, Osakabe N, Natsume M, Muto Y, Takizawa T, Terao J. Absorption and urinary excretion of (−)-epicatechin after administration of different levels of cocoa powder or (−)-epicatechin in rats. Journal of Agricultural and Food Chemistry. 2001 Dec 17;49(12):6050-6.
52. Roura E, Andrés-Lacueva C, Jáuregui O, Badia E, Estruch R, Izquierdo-Pulido M, Lamuela-Raventós RM. Rapid liquid chromatography tandem mass spectrometry assay to quantify plasma (−)-epicatechin metabolites after ingestion of a standard portion of cocoa

beverage in humans. Journal of agricultural and food chemistry. 2005 Aug 10;53(16):6190-4.

53. Chang Q, Zuo Z, Ho WK, Chow MS. Comparison of the pharmacokinetics of hawthorn phenolics in extract versus individual pure compound. The Journal of Clinical Pharmacology. 2005 Jan;45(1):106-12.
54. Zuo Z, Zhang L, Zhou L, Chang Q, Chow M. Intestinal absorption of hawthorn flavonoids–in vitro, in situ and in vivo correlations. Life sciences. 2006 Nov 25;79(26):2455-62.
55. Abdalla AE, Darwish SM, Ayad EH, El-Hamahmy RM. Egyptian mango by-product 1. Compositional quality of mango seed kernel. Food chemistry. 2007 Jan 1;103(4):1134-40.
56. Ali MA, Gafur MA, Rahman MS, Ahmed GM. Variations in fat content and lipid class composition in ten different mango varieties. Journal of the American Oil Chemists' Society. 1985 Mar;62(3):520-3.
57. Aro A, Jauhiainen M, Partanen R, Salminen I, Mutanen M. Stearic acid, trans fatty acids, and dairy fat: effects on serum and lipoprotein lipids, apolipoproteins, lipoprotein (a), and lipid transfer proteins in healthy subjects. The American journal of clinical nutrition. 1997 May 1;65(5):1419-26.
58. Asep EK, Jinap S, Tan TJ, Russly AR, Harcharan S, Nazimah SA. The effects of particle size, fermentation and roasting of cocoa nibs on supercritical fluid extraction of cocoa butter. Journal of Food Engineering. 2008 Apr 1;85(3):450-8.
59. Koo CK, Chung C, Fu JT, Sher A, Rousset P, McClements DJ. Impact of sodium caseinate, soy lecithin and carrageenan on functionality of oil-in-water emulsions. Food Research International. 2019 Sep 1;123:779-89.
60. Lee DY, Lee CY, Shin JN, Oh JH, Shim SM. Impact of soy lecithin, zinc oxide, and methylsulfonylmethane, as excipient ingredients, on the bioaccessibility and intestinal transport of branched-chain amino acids from animal and plant protein mixtures. Food & Function. 2021;12(22):11399-407.
61. Asl MN, Hosseinzadeh H. Review of pharmacological effects of Glycyrrhiza sp. and its bioactive compounds. Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives. 2008 Jun;22(6):709-24.
62. Pastorino G, Cornara L, Soares S, Rodrigues F, Oliveira MB. Liquorice (Glycyrrhiza glabra): A phytochemical and pharmacological review. Phytotherapy research. 2018 Dec;32(12):2323-39.

63. Chaudhari SA, Devare R, Dewang PS, Patil VB, Patil AM, Pawar SP. Chocolate formulation as drug delivery system. Indian journal of drugs. 2018;6(2):136-41.
64. Sunil R, Mounika K, Shalini S, Venkatesham A. Design and fabrication of medicated chocolate formulation by chocolate drug delivery system. Journal of Current Pharma Research. 2016 Oct 1;7(1):2010-20.
65. Pawar PD, Bakliwal AA, Talele SG, Jadhav AG. Formulation and evaluation of herbal chocolate as nervine tonic. Journal of Pharmaceutical Sciences and Research. 2019 May 1;11(5):1808-13.
66. Vasani C, Shah K. Preparation and evaluation of chocolate drug delivery system of albendazole. Research journal of pharmacy and technology. 2016 Nov 1;9(11):1994.
67. Shaikh JR, Patil M. Qualitative tests for preliminary phytochemical screening: An overview. International journal of chemical studies. 2020 Mar 1;8(2):603-8.
68. Peroni DG, Hufnagl K, Comberiati P, Roth-Walter F. Lack of iron, zinc, and vitamins as a contributor to the etiology of atopic diseases. Frontiers in Nutrition. 2023 Jan 9;9:1032481.
69. Mayank S, Kumar JD. Chocolate formulation as drug delivery system for pediatrics. Indonesian Journal of Pharmacy. 2012 Oct 1;23(4):216-24.
70. Chaudhari SA, Devare R, Dewang PS, Patil VB, Patil AM, Pawar SP. Chocolate formulation as drug delivery system. Indian journal of drugs. 2018;6(2):136-41.
71. Gravina SA, Yep GL, Khan M. Human biology of taste. Annals of Saudi medicine. 2013 May;33(3):217-22.
72. Koo CK, Chung C, Fu JT, Sher A, Rousset P, McClements DJ. Impact of sodium caseinate, soy lecithin and carrageenan on functionality of oil-in-water emulsions. Food Research International. 2019 Sep 1;123:779-89.