

## Research Article

# Design and Development of Medicated Chocolate

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**Submitted:** 04 November 2021

**Accepted:** 26 November 2021

**Published:** 27 November 2021

**ISSN:** 2379-089X

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**OPEN ACCESS****Keywords**

- Chocolate
- Medicated chocolate
- Cocoa
- Soy proteins

**Abstract**

The objective behind the study is to formulate a chocolate containing protein by chocolate drug delivery system. As we all know that chocolate is the most popular food running whole world as it's digested easily with high nutritional value. The prepared medicated chocolates are used for pediatric administration; because of its palatability it's being favorite in all the children's. It acts by stimulating the production of endorphin. It also shows presence of theobromine which aids in stimulation purpose. Here the chocolates needed were prepared with the aid of available chocolate base and the incorporation of protein from soya seeds was carried out within it. The soya seeds were selected due to acquirement of higher content of protein in it.

**ABBREVIATIONS**

**LDL:** Low density Lipoprotein **HDL:** High density Lipoprotein

**INTRODUCTION**

Chocolates containing suitable drug incorporated within is known as medicated chocolate. It comes under the novel drug delivery system. Chocolates are semisolid suspension containing minute or fine solid particles in the oily continuous phase. It contains polyphenols, saturated fats, diterpenes, triterpenes, sterols, aliphatic alcohol; cocoa an antioxidant is the major ingredient and methylxanthines flavones. There are different types of chocolate in accordance to percent of cocoa butter and cocoa solid, viz.

- Sweet chocolate: It contains not less than 30% of cocoa solids, of which at least 12% shall be fat free cocoa solid and 18% shall be cocoa butter on dry matter basis.
- Milk chocolate: It contains not less than 25% cocoa solids on dry matter basis.
- Family milk chocolate: It contains not less than 20% cocoa solids on dry matter basis.
- White chocolate: It contains not less than 14% milk solids and not less than 20% cocoa butter on dry matter basis. (1).
- Milk chocolate: It contains not less than 25% cocoa solids, not less than 14% milk and not less than 31% total fat on dry matter basis.

The chocolates are solid at ambient (20-25°C) and melt at oral temperature (37°C) Milk and dark chocolates are different from white chocolates as they show presence of cocoa nibs containing antioxidants, reducing the products shelf-life.

**Benefits of chocolate**

- Maintaining blood pressure and blood glucose level: A study published in 2015 concluded that dark chocolates not only decreased the blood pressure, but also decreased the blood glucose level i.e. fasting blood sugar.
- Antioxidant: By administration of chocolates neutralizes the free radicals and protects the damage of body. The antioxidant property is due to highest content of polyphenols and flavonoids, present highly in dark chocolates.

Prevention of cancer: It is unbelievable but according to American Cancer Institute: 'The chocolates rich in flavonoids, researchers have also investigated whether it may play a role in cancer prevention. The studies of cancer prevention are still emerging.

- Vasodilation: Theobromine present helps in dilating the narrowed blood vessels and improves the blood flow and hence useful in reducing blood pressure.
- Diuretic action: Theobromine acts as a diuretic i.e. It helps in removing excess water by urination from the internal to external environment.

- **Muscle relaxation:** Theobromine has its muscle relaxant property on cardiac tissues.
- **Action against tooth decay:** Theobromine acts against the micro-organisms in the buccal cavity as thereby contributes to prevent the teeth from decaying.
- **Antidepressant action:** Administration of chocolates leads to stimulation of neurotransmitter endorphin, resulting in positive feeling in the depressed person.
- **Memory improvement:** positive effect on the brain is seen due to administration of hot chocolate, which helps in prevention of chronic or degenerative diseases like Alzheimer's disease.

## Soy proteins

The soyabean seeds contains about 80% of proteins. Recently the popularity of soy proteins has been increased due to its use in health food products and many countries allow health claims for foods rich in soy proteins. Seeds of soyabeans contains albumin storage proteins. It also contains Legume proteins, belong to globulin family of seed storage protein called as leguminous and vicilin's, or in the case of soyabeans, glycinin and beta-conglycinin. Soyabeans also contains some biologically active or metabolic protein, The soya cotyledon storage proteins are important for human nutrition and can be extracted by water, water and dilute alkali (pH 7-9), or aqueous solutions of sodium chloride (0.5-2M~30-120g/l) drum dehulled and defatted soyabeans that have undergone only a minimal heat treatment so the protein is close to being native or undenatured.

Soyabean protein is a complete protein as it provides all essential amino acids for human nutrition. Its identical to the other Legume pulses and it is one of the least expensive sources of dietary protein.

## Food Uses

Soy protein is used in a variety of foods, such as salad dressings, soups, meat analogues, beverage powders, cheeses, nondairy creamer, frozen desserts, whipped topping, infant formulas, breads, breakfast cereals, pastas, and pet foods.

## Soy Protein Benefits

**Can be Used as a Meat Protein:** As mentioned earlier, soy protein acts as a good substitute for protein that is obtained from consuming meat. According to the US Food and Drug Administration.

Soy protein products can be good substitutes for animal products because, unlike some other beans, soy offers a 'complete' protein profile. Soy protein products can replace animal-based foods—which also have complete proteins but tend to contain more fat, especially saturated fat—without requiring major adjustments elsewhere in the diet.'

Soy beans also contains amino acids that plays as an essential part in the production of insulin in the body.

**Can Lower LDL Cholesterol:** Including a minimum of 4 servings of soya protein in your diet every day can help lower bad cholesterol, called LDL cholesterol, by 10%. Soya helps to balance

out the bad cholesterol level without impacting the level of good cholesterol or HDL cholesterol.

**Prevents Heart Disease:** As mentioned earlier, Soy protein helps to lower the level of LDL cholesterol in the body, this in turn can lower the chances of heart disease drastically. If you want to keep your heart healthy, make sure that your diet consists of soy protein. Doing so will not only help reduce cholesterol over time, but will also add to healthy veins, and improve blood flow to the heart.

**Energy Booster:** Soy proteins contain amino acids that can be found in tofu and soy milk. These amino acids can be used effectively by the body and converted into energy.

**Reduces Other Health Risks:** Soy protein is also useful in preventing several other serious health conditions. It can prevent colon cancer cells, prostate cancer and in some cases, cure osteoporosis too.

**Pregnancy:** It is advised to use soy products while pregnant to benefit from its numerous health benefits. Fortified soy milk contains a good amount of vitamin D, unlike other dairy products. Vitamin D is essential for stronger bones of both mother and child. Pregnant women can get vitamin D from exposure to sunlight and also from consuming soy milk. So if you are not getting sufficient time out in the sun or are lactose intolerant, you can enjoy soy milk benefits.

**Obesity and Diabetes:** Soy protein is useful in controlling hyperglycemia and losing weight. Diabetes is a serious medical condition. Inclusion of soy beans in diet can not only control obesity but also help balance the sugar levels in the body. This is the perfect food choice for diabetic patients!

**Cancer Prevention:** Genistein- phytochemicals that are found in soy can lower the risk of breast and prostate cancer. Genistein can prevent cancer by halting tumor cells from growing. You can consume 1 cup soy milk or ½ cup tofu or even soybeans to be protected from the risk of cancer.

**Menopausal Symptoms:** Phytoestrogens acts as synthetic estrogen that protects women from severe bone loss and helps in maintaining a healthy heart. Soy protein also helps to maintain stronger bones and calcium balance in postmenopausal women.

**Prevent Osteoporosis:** Osteoporosis is a disease caused due to age and hormonal problems. The phytoestrogen content in soy can increase the calcium absorption by the body and help in the prevention of bone mass loss. To get the best benefit, always buy soy milk which is fortified with some extra calcium and even vitamin D.

## MATERIALS AND METHODS

### Materials

Soy proteins, Chocolate base containing cocoa butter, cocoa powder, pharmaceutical grade sugar, edible fat oil (Hydrogenated), Emulsifiers, and flavoring agents' vanilla.

### Method of preparation

The chocolate base containing cocoa powder, cocoa butter, pharmaceutical grade sugar was prepared.

1. Preparation of chocolate base: Initially the sugar was dissolved in water and heated at 50°C for 3 minutes. Next cocoa butter was melted and addition of above prepared sugary solution with cocoa powder was carried. Further the mixture of cocoa butter, cocoa powder and sugary solution was cooled for short time and flavouring agent i.e., Vanilla was added.
2. Preparation of soy proteins: The seeds of soybeans were freed from the dust particles, other impurities, etc. Next those seeds were roasted till they become reddish-brown. Further grinding was carried out homogenously.
3. Preparation of chocolate: Set the oven at 50°C and melt the above prepared chocolate base till it acquires liquid consistency. Further the soy proteins were added according. The stirring with magnetic stirrer was carried out for 5-10 minutes for the aid of uniform mixing. After the mixing the mixture was poured in the suitable mould to get a suitable shape and if necessary, it is kept in the refrigerator for 5 minutes.
4. The medication chocolates were further evaluated by undertaking different parameters. (Table 1) (Figure 1).

**Table 1:** Formulation table.

Sr. No.	Ingredient	Quantity	Category
1	Soy protein	5 gm	Drug
2	Cocoa powder	5 gm	Principle ing.
3	Cocoa butter	500 mg	Solidifier
4	Emulsifier	30 mg	Emul. agent
5	Vanilla	Q. S	Flav. agent

**Figure 1** Image of Chocolate formulation.

## EVALUATION PARAMETERS

### Evaluation of chocolate base

Texture and mouth feel characters:

These parameters of chocolate base were evaluated, weather the texture of base is smooth, rough, creamy, etc. and the results were noted.

### Evaluation of chocolate

**Thickness:** Thickness of 5 formulated chocolates from each batch was determined with the aid of Vernier caliper. The formulation thickness should be in the limit whose thickness should not exceed  $\pm 5\%$  of the size of formulation.

**Weight variation test:** According to USP the weight variation test was carried out in which 5 formulations from each batch were selected and the average weight of each formulation were noted.

**Disintegration test:** As per USP the disintegration test was carried out by using disintegration test apparatus at  $37 \pm 0.5^\circ\text{C}$  at 60 rpm

### *In vitro* release studies:

Dissolution conditions:

- Apparatus: USP Type II apparatus.
- Dissolution media: phosphate buffer of pH 6.8. Temperature:  $37 \pm 0.5^\circ\text{C}$ .
- Rotating speed of paddle: 60 rpm.
- Sample interval: 10, 20, 30, 40, 50, 60 minutes. Detection: 254nm using UV visible spectrophotometer.

## RESULTS AND DISCUSSION

### Evaluation of chocolate base Texture and mouth feel

- These parameters of chocolate base were evaluated by taking 5 volunteers.
- The results were obtained as follows;
- Texture: smooth, free from crystals.

### Evaluation of physico-chemical parameters

1. General appearance (Table 2)
2. Thickness (Table 3)

It is done by Vernier caliper. The thickness of formulation was uniform in all 3 batches. It is shown in table: 3.

The weight variation study was performed according to USP and is shown in table: 4. The weights of the formulation were approximately uniform it did not show the sticky nature during formulation. Hence the formulation has passed weight variation test. (Table 4)

**Table 2:** General Appearance.

Sr. No.	Characteristics	Results
1	Color	Dark brown
2	Odour	Pleasant
3	Texture	Smooth

**Table 3:** Thickness of chocolate.

Sr. No.	Formulation	Thickness (cm)
1	F1	10.5±0.2
2	F2	10.8±0.7
3	F3	11.3±0.4

**Table 4:** Weight variation test.

Formulation	Weight variation (gm)
F1	9.5±3
F2	9.9±5
F3	10.5±2

**Table 5:** Disintegration test.

Formulation	Disintegration (min.)
F1	23±3
F2	22±5
F3	19±2

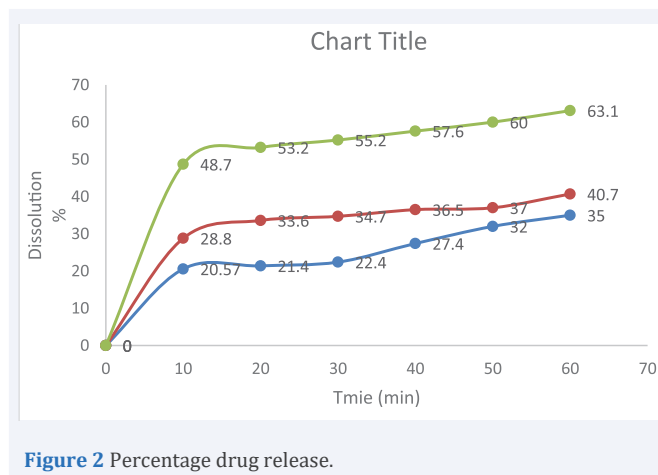
**Table 6:** *In vitro* drug release.

Time(min)	F1(%)	F2(%)	F3(%)
0	0	0	0
10	20.57	28.8	48.7
20	21.4	33.6	53.2
30	22.4	34.7	55.2
40	27.4	36.5	57.6
50	32.0	37.0	60.0
60	35.0	40.7	63.1

### Disintegration test

This was also performed as per USP and shown in table:5. The average time for disintegration of chocolate was in sufficient range. (Table 5)

Calorie calculation: Calories = (gm of protein) (4) + (gm of fat) (9) + (gm of total carbohydrate) - (gm of dietary fiber) (4) = (3.5) (4) + (36) (9) + (58) - (34) (4)

**Figure 2** Percentage drug release.

**In-vitro drug release studies:** Chocolate formulation was subjected to in-vitro studies using 6.8 pH phosphate buffer to check the percentage drug release at specific interval of time. The results are shown in table 6. (Table 6) (Figure 2)

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### Cite this article

Vijay M, Mahajan N, Shah R, Mali K, Salunkhe N, et al. (2021) Design and Development of Medicated Chocolate. J Drug Des Res 8(3): 1089.