

EXPLORING FORMULATION AND EVALUATION OF SIMETHICONE MEDICATED CHOCOLATE FORMULATION FOR ANTI- FLATULENCE EFFECT

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ABSTRACT

The target of study is to formulate and evaluate a nutritious simethicone chocolate with least number of side-effects and its interactions. Simethicone primarily acts in the stomach and intestine which lessens the surface tension of small number of bubbles resulting in coalescence into larger bubble leading to elimination of gas through flatus and belching. Chocolate/cocoa has been known for its good taste and proposed health effects from centuries. Most of the drugs are bitter or bland due to which oral administration of these drugs leads to patient non-compliance especially in children. Cocoa which is the chief ingredient of many chocolate formulations was

substituted with carob (*Ceratonia siliqua*) because cocoa containing formulation requires huge amount of sugar content and it contains caffeine causing stimulation of CNS. Although carob contains sweeteners naturally; contains no fat, no caffeine, no oxalates it becomes beneficial tremendously. The medicated chocolate was prepared by incorporating Simethicone into chocolate base which was made from carob powder, cocoa butter, peanut butter and was evaluated for general appearance, moisture content determination, fat bloom test, hardness test, its dimension, and stability in packaging material. Disintegration test was performed by using artificial saliva as its medium in order to note the time required to disintegrate the base and report the time at which the drug is released.

KEYWORDS: Simethicone, Medicated chocolate, flatulence, Antiflatulence, Carob.

INTRODUCTION

The feeling of abdominal fullness, tightness, and motion of gas in the abdomen is a very excruciating condition.^[1] Flatus -A physical state of gastrointestinal tract with a huge amount of gases like carbon dioxide, hydrogen gas and methane along with small amount of the inflammable gases like hydrogen sulphide.^[2] One of the most important causes of flatulence is an incorrect manner of eating^[3] and passage of excessive amounts of gas and the feeling of abdominal fullness and bloating. Flatulence is one of the most usual complaints of patients.^[4] Antiflatulents decreases the symptoms of excess gas production in the gastrointestinal tract. Commonly used antiflatulents are Simethicone, charcoal and many more.^[5]

Although Simethicone covers more than 50 years. The main properties of simethicone are the deforming reduction of surface tension and the reduction of surface viscosity and hydrophobicity which enable simethicone to spread easily over surfaces.^[6] It is a silicone derivative possessing deforming action which helps relieve flatulence by dispersing gas pockets trapped in the GI tract. It alters the surface tension of gas bubbles, facilitating their coalescence. The pain of dyspepsia, spastic colon, diverticulitis and post operative antonym is relieved.^[5] It is physiologically inactive and nontoxic. It can be taken orally and cannot be absorbed through gastrointestinal system.^[6] It does not have any known drug interaction, and no significant complication has been reported for it^[29] and do not interfere with gastric secretion or absorption of nutrients. Following oral administration, the drug is excreted unchanged in feces.^[30] Simethicone likely acts in contact with the endogenous surface-active substances lining the gut mucosa. The effects of simethicone are those related to the intraluminal actions of the compound in the digestive tract, since it is not absorbed and is virtually non-toxic^[7] A poly (dimethylsiloxane) is a type polymer of 200-350 units of dimethylsiloxane, along with a silica gel is added. It is used as an antiflatulent, surfactant, and ointment base.^[8] The pharmacological data suggest that while simethicone (i.e. dimethicone +SiO₂) has an antifoaming effect which is 10³ –10⁴ higher than either substance alone,^[2] whereas the mucosal protective effects are solely linked to the dimethicone part of the formula.^[9] Medicated chocolate is prepared by using chocolate base and the drug is incorporated into prepared chocolate base. As chocolate is extremely sophisticated and multifaceted food that is combined to create entirely divergent taste and texture sensations.^[10]

Chocolate is well-suited as a vehicle for delivering active agents in many aspects. For example, the organoleptic characteristics of chocolate are excellent for masking unpleasant flavors associated with some active agents and giving a smooth and creamy texture to compositions of active agents that are otherwise undesirably gritty^[11] A chocolate base is prepared by use of cocoa powder, cocoa butter, lecithin, and pharmaceutical grade sugar. Cocoa is the principle ingredient of chocolate and it is rich in polyphenols, particularly in flavanols such as epicatechins, catechins, and polycondensed flavanols. Research studies suggest that a high intake of dietary flavonoids, a subgroup of polyphenols, chocolate may reduce the risk of coronary heart disease, Caffeine and theobromine are well-known stimulants, and oxalic acid in the chocolate formation which when comes in contact with human tissues, reacts with calcium to form calcium oxalate, which forms part of a kidney stone^[12] Based on the high oxalic acid content in cocoa, chocolate is considered as a high-oxalic acid food and The Oxalosis and Hyperoxaluria Foundation recommends that persons with kidney problems should avoid eating chocolate because it may be problematic for some kidney stones, autoimmune disease, autism and may more^[14] In fact, carob powder has nutritional advantages over cocoa powder by having lower contents of fat (0.6%) and higher dietary fiber (40%) and carob beans contain high pectin content which soothes intestinal problems and act as a prebiotic which feeds intestinal bacteria^[15] Because of its high sugar content (50%), of which 70% to 80% is sucrose, carob reduces the addition of processed sugar when used as a cocoa replacement^[16] Cocoa has a high fat content (10-25%), high amounts of hydrophobic polysaccharides, and its capillary structure traps air bubbles because it has low solubility^[17] Additionally, it is well established that carob powder is free of the two anti-nutrients found in cocoa: caffeine and theobromine^[18] Carob powder was rich source of Fe, Ca, Na, K, P and S as well as E, D, C, Niacin, B6 and folic acid.^[19] Many previous studies have reported a cocoa-like aroma in roasted carob^[20] Moreover, roasting of the carob powder not only improves its color and flavor, but also results in an increase in the phenolic contents and antioxidant capacity^[21] and contain nutritionally important amino acids (aspartic and glutamic acids, alanine, valine) and minerals (K and Ca)^[22] Roasting at 150 °C for 60 min was found to be the most appropriate heat treatment to improve the desirable characteristics of carob powder along with improvement in the flavor profile by reducing the concentration of isobutyric acid, which has an undesirable flavor^[23] Improvement in the aroma of the roasted carobs can also be attributed to a reduction in acids, alcohols, and aldehydes, accounts 91.4% of the total 137 aroma components are determined, and an rise in the amounts of furans, esters, and pyrroles it is demonstrated that a cocoa substitute with same characteristics to

cocoa can be produced through Maillard technology by using a mixture of milled chicory roots and carob pods. In some countries, carob kibble is already in use as a cocoa replacer or extender.^[24]

Carob (*Ceratonia Siliqua*) belongs to the subfamily Caesalpinioideae of the Leguminosae family, it is a typical tree of the semiarid environments in the Mediterranean area. The fruit of carob tree is composed by pod (90%) and seeds (10%)^[25] which has a high content of insoluble fiber and polyphenols (tannins), with supposed beneficial effects for human health^[26] Traditionally important main products of carob are pods, seed gums and derived products like carob bean flour, pekmez (concentrated carob syrup /molasses), health foods (as a chocolate substitute), carob syrup and medicines such as laxatives and diuretics^[19] and as a potential ingredient in cereal – derived foods for celiac people^[27] It is also remunerated as antioxidant, have cholesterol lowering effects, anticarcinogenic, antidiabetic properties.^[28]

MATERIAL AND METHOD

SIMETHICONE API acquired from Ideal College of pharmacy and research drug store. Carob powder and peanut butter was purchased from urban platter sun drop peanut butter regular, respectively whereas cocoa butter was obtained online from minimal pure cocoa butter.

Methodology

1. Requiements

#Sieve no. 8, Glass rod, Beaker, Polyethylene mould, silver foil

2. Intregients

Cocoa butter, carob powder, peanut butter, simethicone A.P.I.

3. Formulation of chocolate base-

Chocolate was formulated with total content of carbohydrates (75.92%), proteins (6.34%) and low level fats (1.99%), crude fiber content of about 7.30%; rich source of Fe, Ca, Na, K, P and S.^[19] from carob flour.

4. Method of preparation of chocolate base

- Carob powder was sifted.
- Cocoa butter was taken and melted using double boiler over the bursen's burner. (Temperature must not exceed about 40°C)
- Sifted carob powder was added to melted cocoa butter and mixed well.

- Peanut butter was added and uniformly mixed with the magnetic stirrer (for uniform mixing of all ingredients as well as drug A.P.I)
- Poured the above formulation in the polyethylene mould and kept it for a while at room temperature then cooled for about 4 hrs in the freezer
- Careful attention is paid to the chocolate manufacturing process to ensure that the temperature of the mixture is not too high.

Table no 1: Formulation 1.

Sr.no	Ingredients	Category	Quantity
1.	Carob powder	Principle Ingredient	1 gm
2.	Cocoa butter	Solidifying agent	2 gm
3.	Peanut butter	Emulsifier	½ Tsp

Table no 2: Formulation 2.

Sr.no	Ingredients	Category	Quantity
1.	Carob powder	Principle Ingredient	1 gm
2.	Cocoa butter	Solidifying agent	2 gm
3.	Peanut butter	Emulsifier	½ Tsp

Table no. 3: formulation 3.

Sr. no	Ingredients	Category	Quantity
1.	Carob powder	Principle Ingredient	1 gm
2.	Cocoa butter	Solidifying agent	2 gm
3.	Peanut butter	Emulsifier	½ Tsp

(Three different formulas were used to prepare chocolate base, after final formulation it was found that FORMULATION 2 was having excellent appearance and has maintained its physical state at best so it was finalized to prepare medicated chocolate.)

5. Method of preparation of medicated chocolate-

Formula

Table no. 4: Formulation 4.

Sr. no	Ingredients	Category	Quantity
1.	Simethicone API	Drug	100 mg
2.	Carob powder	Principle Ingredient	1 gm
3.	Cocoa butter	Solidifying agent	2 gm
4.	Peanut butter	Emulsifier	½ Tsp

(When active drug was incorporated into finalized chocolate base it was found that it has maintained its physical state at its best, and later various evaluation test very performed to check its efficacy).

- Carob powder was sifted.
- Cocoa butter was taken and melted using double boiler over the bursen's burner. (Temperature must not exceed about 40°C)
- Simethicone A.P.I is added and stirred until it is uniformly mixed with the cocoa butter
- Sifted carob powder was added to melted cocoa butter and mixed well.
- Peanut butter is added and uniformly mixed with the magnetic stirrer (for uniform mixing of all ingredients as well as drug A.P.I)
- Poured the above formulation in the polyethylene mould and kept it for a while at room temperature then cooled for about 4 hrs in the freezer
- Careful attention is paid to the chocolate manufacturing process to ensure that the temperature of the mixture is not too high.

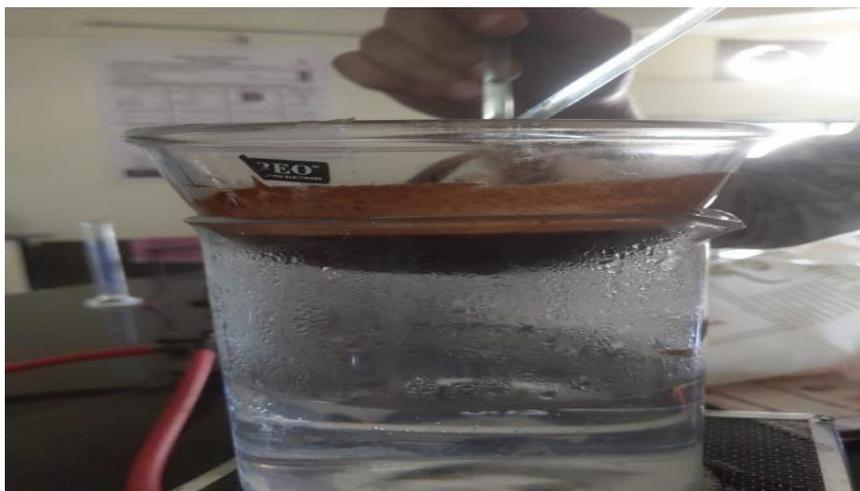


Fig no. 1.

6. Double boiler usage

- Simply fill the bottom pot with one or two inches of water
- Next, add in the top pot ingredient needed to heat
- Turn on the burner to a simmer (as the water heats up and steam is released, the steam stays trapped between the two pots, which then heats the ingredients in the top pot)

7. Tips for working with chocolate-

- Work in an absolutely clean, grease and odour-free area.
- Make sure the temperature of the room isn't too hot (68°F is ideal; no higher than 72°F).
- Remember, chocolate is an oil-based product, and oil and water don't mix. The slightest amount of water or steam can ruin a bowl of chocolate. Everything that comes in contact with your chocolate—tools, work area, or other ingredients—must be absolutely dry.

Evaluation

- ❖ **General appearance:** The general appearance of a chocolate formulation is determined by observing its visual identity and overall “elegance” is necessary for consumer acceptance and for observing trouble free manufacturing.
- ❖ **Dimensions:** Dimension of the chocolate was measured by using Vernier’s callipers.
- ❖ **Moisture content determination:** Moisture content determination was determined by using Desiccator This test was carried out to check the moisture present in the chocolate at dry condition. The prepared chocolate formulation were weighed accurately and kept in a desiccator containing anhydrous silica gel. After 24hrs, the formulations were taken out weighed and % Moisture Absorption was calculated by using formula

$$\% \text{Moisture} = \frac{\text{Initial wt} - \text{Final wt}}{\text{Intial wEIGHT}}$$

- ❖ **Blooming test**



Fig. no. 2.

- **Fat bloom test**

Fat bloom appears as light colour spots on the chocolate. As the name says, the bloom is composed of fat, in this case the naturally occurring fat that comes from the cacao bean - cocoa butter. A soft white layer will appear gives bland look.

- 1) Sample was subjected to 40c for 8 hours, and Temperature is shifted for 20c.
- 2) A test sample was observed, after the step of 20c for 8 hours whether bloom has taken place or not.

❖ Viscosity determination of chocolate base

The viscosity was determined by using Brookfield rotational viscometer where the spindle was rotated at 50rpm and chocolate base was heated at 50c before measurements were taken.

❖ Weight variation

Six Chocolate formulation were weighed individually and all together. Average weight was calculated from the total weight of all chocolate. The individual weights were compared with the average weight. The percentage difference in the weight variation should be within the permissible limits. The percent deviation was calculated using the following formula:

$$\text{Percentage deviation} = [(\text{Individual weight} - \text{Average weight}) / \text{Average weight}] \times 100$$

❖ Hardness test

Hardness is a force required to break a chocolate across the diameter. The hardness of a chocolate is an indication of its strength. The hardness was measured using Monsanto Hardness tester. The values were expressed in Kg/cm² [29]

❖ Disintegration test

Disintegration time was measured in artificial saliva (pH 5.8) of 900 ml, without disc at 37 ± 5° c temperature. The disintegration time of six individual chocolate is recorded and from this the average weights are calculated and the time in seconds recorded for complete disintegration of the chocolate. [30]

Saliva formulation. [31]

Table no. 5.

Composition	Quantity per 1000g
Potassium chloride	0.96g
Sodium chloride	0.67g
Magnesium chloride	0.04g
Potassium phosphate	0.27g
Calcium chloride	0.12g
Methyl paraben	0.01g
Propyl paraben	0.1g
Methyl p-hydroxybenzoate	8.0g
Sorbitol	24g
Water	1000ml

❖ Efficacy test of Simethicone A.P.I

- Label the two Beaker. One beaker labeled with “WITH SIMETHICONE”; on the other one “WITHOUT SIMETHICONE.”. Crush the chocolate formulation With and without

simethicone into a powder. Carefully put all the powder into the beaker labeled WITH Simethicone and without simethicone appropriately. Fill both Beaker with water until they are about half full. Mix the water solution with simethicone chocolate formulation powder thoroughly. Slowly blow through the straw put in the beaker with simethicone containing formulation for about 10 seconds. Next, slowly blow through the straw in the cup without simethicone containing formulation, again for 10 seconds.

Now, add about five drops of detergent into each of both beakers. Stir the solutions with the stirrer. Once mixed in the liquid detergent, again slowly blow through the straw into the beaker without simethicone for about 10 seconds. Repeat the above step but with the beaker that contains the simethicone and detergent. ^[32]

❖ Stability

Stability of medicinal products may be defined, as the capability of a particular formulation in a specific container to remain within its physical, chemical, microbial, therapeutic and toxicological specification, i.e. stability of drug is its ability to resist deterioration. 90% of labelled potency is generally recognized as the minimum acceptable potency level. Deterioration of drug may take several forms arising from changes in physical, chemical and microbiological properties. The changes may affect the therapeutic value of preparation or increase its toxicity^[33]

RESULT AND DISCUSSION

a. General appearance

Table no. 6.

Serial no:	Characteristics	Result
1.	Color	Dark brown
2.	Odor	Pleasant
3.	Taste	Sweet
4.	Surface texture	Smooth, Silk

b. Dimension

Average width of six chocolate formulation
$$: \frac{1.89+1.79+1.89+1.89+1.89+1.89}{6}$$

10 division of Vernier's scale = coincide 9 division of main scale

1 division of Vernier's scale = 0.09 division of main scale

c. Moisture content determination

Weight of formulated chocolate = 3.26gm

Weight of empty crucible = 44.38gm

Weight of formulated chocolate +weight of empty crucible = 47.64gm

Weight after moisture loss = 47.93gm

So, final weight obtained = 0.06gm

Weight of one chocolate formulation = final weight obtained

3.26gm = 0.06gm

100gm = x

X = $\frac{0.06 \times 100}{3.26}$

So, x = 1.84%

Percentage of moisture content present = 1.84%

d. Bloom test**Fat bloom test**

- Sample was subjected to 40c for 8 hours, At hot air oven
- A test sample was observed, after the step of 20c for 8 hours



= Bloom obtained

Fig. no. 3.

e. Viscosity determination of chocolate base = 520cp viscosity = 0.52kg/ms



Fig. no. 4.

f. Weight variation determination

Average weight of six chocolate formulations: $\frac{W_1+W_2+W_3+W_4+W_5+W_6}{6}$

Average weight of six chocolate formulation: $\frac{3.52+3.26+3.50+3.60+3.42+3.65}{6} = 3.49$

➤ The per cent deviation was calculated using the following formula

• **Percentage deviation of W_1 formulation**

= [(Individual weight-Average weight) / Average weight] × 100

= $3.52-3.49 \times 100/3.49$

= 0.85%

• **Percentage deviation of W_2 formulation** = $3.26-3.49 \times 100/3.49 = -6.59\%$

• **Percentage deviation of W_3 formulation** = $3.50-3.49 \times 100/3.49 = 0.28\%$

• **Percentage deviation of W_4 formulation** = $3.60-3.49 \times 100/3.49 = 3.15\%$

• **Percentage deviation of W_5 formulation** = $3.42-3.49 \times 100/3.49 = -2.00\%$

• **Percentage deviation of W_6 formulation** = $3.65-3.49 \times 100/3.49 = 4.58\%$

➤ **Average Percentage deviation = 0.045%**

g. Hardness test

Initial reading of Hardness tester = 3kg/cm

After breakage of chocolate = 9kg/cm

Hardness present in the chocolate formulation = 9-3kg/cm
=6kg/cm

h. Disintegration test

Disintegration time required for chocolate formulation to disintegration into smaller particle:
3.20 minutes



Fig. no. 5.

i. Efficacy test of simethicone A.P.I



Fig. no. 6.

Fig. no. 5.

After addition API the Foam disappeared after keeping it for 2 min

J. Stability test in selected packaging material**Fig. no. 7.****Fig. no. 8.**

After 24 hrs in the package of foil on exteriorly and inside shiny butter paper by keeping at room temperature

CONCLUSION

From the above study, in the nutshell we conclude that formulated medicated chocolate are smooth in texture and pleasant in taste having patient compliance and safety with the incorporated bland tasted simethicone medication from the paediatric to geriatric patients of all age group. Subsequently more benefitted than the normal chocolate formulation with the integration of carob powder which improves gastric problem than the normal chocolate formulation containing cocoa powder which causes various GIT disorders such as acidity, indigestion.

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