



## Medicated Chewing Gums: A Simplified Approach Towards Advanced Type of Drug Delivery

Smiya Mathew\*, Femy Maria K.M, Praveenraj R, Daisy PA  
 ST Josephs College of Pharmacy, Dharmagiri Campus, Cherthala, India.  
 \*Corresponding author's E-mail: [smiyamathew52@gmail.com](mailto:smiyamathew52@gmail.com)

Received: 22-02-2021; Revised: 14-04-2021; Accepted: 21-04-2021; Published on: 15-05-2021.

### ABSTRACT

Medicated chewing gums (M.C.G) are well known for patient convenience because of its ease of administration. They can very well be used for acute treatments. M.C.G's contain one or more active ingredients, which are released by chewing and are intended to be used for treatment of diseases in mouth and also for systemic delivery. Chewing of gums reduces the risk of dental caries. MCG's are also used for smoking cessation, xerostomia, allergy, motion sickness etc. This review aims in throwing light on various aspects of M.C.G's like its merits, demerits, various ingredients, manufacturing processes etc.

**Keywords:** Chewing gums, saliva, MCG, dental caries.

### QUICK RESPONSE CODE →

DOI:  
10.47583/ijpsrr.2021.v68i01.005



DOI link: <http://dx.doi.org/10.47583/ijpsrr.2021.v68i01.005>

### INTRODUCTION

Medicated chewing gum (MCG) is an advanced drug delivery system which contains masticatory chewing gum base with an active ingredient. MCG is a solid or semisolid dosage form consisting of one or more active ingredients that are incorporated in water insoluble base<sup>1</sup>. The main ingredient in the formulation is the gum base. The active ingredients as well as the excipients are incorporated into it. It is mainly used for diseases in oral cavity or systemic absorption via oral mucosa. Now a days MCG is achieving a great impact as it is a better route of drug delivery<sup>4</sup>. The drug which are acting in the oral mucosa usually have low water or saliva solubility. Some of the international terms for identifying chewing gum are “goma de mascara in Argentina”, “kaugummi in Austria”, le chewing gum in France”, ellk in Arabian area<sup>1</sup>. Thus, it is considered as an international habit expert in some countries like Singapore and UAE because of their religious concept. Many medications are used as MCGs. Eg: chlorhexidine as local disinfectant, nicotine for smoking cessation, aspirin as an analgesic<sup>2</sup>. US is the leading producer for medicated chewing gum (approx. 50% world market).

### HISTORY OF MEDICATED CHEWING GUM

Thousand years ago, Mayan Indians chewed tree resins for the freshening the breath. Chewing gum was available in AD 50 also, where Greek people used to cleanse their teeth by using mastiche which is a resin from bark of tree called

mastic. The first patent for chewing gum was filed in 1869 and it is issued to Mr. W.F semple in chio under US patent NO.98,304. The first MCG is aspergum which was launched in 1928. This formulation consists of acetyl salicylic acid. i.e..., Aspirin tablets for their analgesic effect. First commercially available chewing gum is spruce gum in 1848, commercially called “STATE OF MAINEPURE SPRUCE GUM”. By 1892, due to the popularity of chewing gum Wrigley launched his first chewing gum LOTTA and VASSAR. After a year he developed another gum called Wrigleys spearmint gum. Sugarless gum was first invented in early 1950s, it is used as sugar substitute<sup>1</sup>.

### Merits of Medicated Chewing Gum

- ❖ Used for candidiasis, dry mouth, and caries
- ❖ Highly acceptable for children
- ❖ By passes first pass metabolism so increases the bioavailability of drugs.
- ❖ Fast onset of action
- ❖ Quick release of active ingredients in buccal cavity due to mastication process
- ❖ Reduces the risk of intolerance of gastric mucosa as stomach doesn't suffer from contact with high concentration of active ingredients
- ❖ Drugs shows higher rate of absorption than conventional tablets<sup>6</sup>.  
Eg: caffeine
- ❖ Increases flow of saliva in mouth
- ❖ Helps to brighten the teeth and reduces stain
- ❖ Good taste
- ❖ Treatment can be terminated at anytime
- ❖ Low cost, easy to carry



### Demerits of Medicated Chewing Gum

- ❖ Risk of over dosage than tablets or lozenges
- ❖ Presence of sorbitol in MCG formulation can cause flatulence and diarrhoea
- ❖ Additives like flavouring agent can cause ulcers and presence of liquorice cause hypertension.
- ❖ Chewing for a long period may cause pain in facial muscles.

### Mechanism and Factors Affecting Drug Release<sup>5</sup>

Active ingredient in the medicated chewing gum is released to saliva by chewing process.

- **Contact time:** Medicated chewing gum can produce local and systemic effect due to the time of contact. Average chewing rate is 60 chews/ minute
- **Physicochemical properties:** Hydrophilic drugs are easily soluble in saliva and lipophilic drug are firstly released to gum base and then to saliva
- **Inter individual variability:** chewing frequency and chewing intensity is varied from person to person<sup>5</sup>

### MCG in Modern Drug Delivery System

- Chewing gum for analgesic and antithrombotic activity: Aspergum
- Chewing gum with anticandidial activity<sup>3</sup>
- Nicotine gum for smoking cessation
- Anti emetic chewing gum
- Chewing gum with acid neutralisation /antacid activity
- Chewing gum for oral hygiene<sup>3</sup>
- Chewing gum for general health
- Memory enhancer/ CNS stimulating chewing gum
- Cold relief chewing gum
- Tobacco stain removal chewing gum
- Chewing gum for enzyme activity
- Chewing gum in thyroid therapy

### Chewing Gum and Saliva:

- ✚ Saliva dilutes and washes away the food debris
- ✚ Saliva has got antibacterial activity
- ✚ Bicarbonate present in saliva neutralises and buffers plaque acids

Chewing gum increases the saliva without drugs. Also, saliva is vital for good health.<sup>7</sup>

### Taste and Texture:

Chewing gum should have a pleasant taste and texture because most of the active ingredients have unpleasant,

bitter taste. So MCG should possess pleasant taste as it releases and remains in buccal cavity for a long time, as the Chewing time is usually 10 to 20 minutes.

### Composition of Medicated Chewing Gum

Natural or synthetic gums and resins sweetened with sugar, corn syrup, artificial sweeteners, coloring agents and flavours are used in the formulating of chewing gum.

The basic ingredient in the chewing gum is gum chicle, that is obtained from sapodilla tree. Other natural gum or synthetic material like polyvinyl acetate are used as chicle is very expensive and difficult to obtain.

Chewing gum mainly contains two parts

- Water insoluble gum base
- Water soluble portions<sup>4</sup>

✚ **Water insoluble gum base:** Consist of elastomers, resins, fats, oils, and inorganic fillers.

**Elastomers:** It provides elasticity and also controls the gummy like texture of the chewing gum. Solid elastomers are more suitable for chewing gum. Natural elastomers like chicle, natural rubber, jelcitong, balatea, gutta – percha...etc and synthetic elastomers like butadiene styrene copolymer, polyisobutylene, isobutylene- isoprene are also used<sup>2</sup>.

**Plasticizers:** Mainly used for regulating the cohesiveness of the product. Two types are available: Natural and synthetic

Examples of natural plasticizers used are natural resin esters like glycerol esters, polymerised glycerol esters, pentaerythritol esters of resin.

Examples of synthetic plasticizers are terpene, resins derived from alpha pinene and or d-limonene

**Fillers:** It provide texture used for improving chewability. Examples of fillers are magnesium and calcium carbonate, ground limestone, magnesium and aluminium silicate, clay, alumina, talc, titanium oxide and mono/di/tri/ calcium phosphate.

✚ **Water soluble portions:** consist of bulk sweeteners, high intensity sweeteners, flavouring agents , softeners, emulsifiers, colours and antioxidants.

**Softeners and emulsifiers:** For optimising the chewability and mouth feel of the gum, softeners and emulsifiers are used. Eg's for softeners include glycerine, lecithin, tallow, fatty acids like and stearic acid, palmitic acid, oleic acid and linoleic acid<sup>3</sup>.

**Colourants and whiteners:** Examples are FD & C type dyes and lakes, fruits and vegetable extracts, titanium dioxide.

**Sweeteners:** 2 types of sweeteners are used

- 1) Aqueous sweeteners.
- 2) Bulk sweeteners



**Aqueous sweeteners:** used for retaining moisture and also for mixing the ingredients. Examples include sorbitol, corn syrups.

**Bulk sweeteners:** consists of sugar and sugarless compounds. Sugar compounds contains saccharides like sucrose, dextrose, maltose. Sugar less components include sugar alcohols like sorbitol, mannitol, xylitol and hydrogenated starch hydroxylate.

**Bulking agents:** It is used, when low calorie gum is required. Low calorie bulking agents are polydextrose, oligofructose, inulin, guar gum hydroxylate, indigestible dextrin.

**Flavouring agents:** used for improving flavours in chewing gum formulation. Flavouring agents includes essential oils such as citrus oil, fruit essence, peppermint oil, mint oil, clove oil, spearmint oil. Artificial flavouring agents are also used.

#### Active Component<sup>4</sup>

Active component is present in the core or coat or in both of the medicated chewing gum formulation. Proportion varies from 0.5% to 30%. Unionised and lipophilic stable active agent is more readily absorbed. Ingredient soluble in saliva released within 10 to 15 min of chewing while lipid soluble agent first dissolve in gum base and then release slowly.

#### Manufacturing Process

Different methods are used for manufacturing of chewing gums.

Broadly classified into three groups:

- ✚ Conventional/traditional method (melting).
- ✚ Freezing, grinding and tableting method.
- ✚ Direct compression method.

#### Conventional or Traditional Method:

Gum base components are melted and should be kept in a kettle mixture and other excipients, syrups, active ingredients are added at the correct time. Then the gum is passed through series of rollers to form thin wide ribbon. During this process, light powdered sugar coating was also added to prevent the gum from sticking and also for enhancing the flavour. After that gum was cooled up to 48 hours in a carefully controlled room. This helps the gum to set properly. Finally the gum was cut to required size at definite temperature and humidity.

#### Limitation:

- Thermolabile drugs cannot be used due to increased temperature for melting.

#### Cooling, Grinding and Tableting Method

This method is developed for decreasing the moisture content and to prevent the limitation of conventional method.

#### Cooling and Grinding

The chewing gum base cooled up to a temperature and should remain brittle during the grinding process without adhesion to grinding apparatus. Generally, the cooling temperature was around -15°C or lower. Then the cooled composition is crushed to obtain the finely ground pieces of composition. Presence of solid carbon dioxide enhances the efficiency of grinding process. Sometimes precipitated silicon dioxide is mixed with the chewing gum composition as an anticaking agent. This helps to prevent agglomeration 2-8% by weight of grinding aid such as alkaline metal phosphate or malto dextran is incorporated for preventing the gum from sticking to grinding apparatus.

#### Tableting

When coolant is removed, powder is mixed with other excipients like binders, lubricants, sweeteners etc. All these ingredients should be compatible with the chewing gum base in a suitable blender like sigma mill. Fluidized bed reactor (FBD) is also used. FBD is more beneficial because it partially rebuild the powder into granules, also coats powder particles with coating agents hence decreasing agglomeration. Then it is mixed with anti-adherents like talc. Then it is blended with V-type blender. The final blend is then taken for compression by punching<sup>7</sup>.

It requires special tableting equipment for careful monitoring of humidity during tableting process.

#### Use of Directly Compressible Chewing Gum Excipients

Manufacturing can be significantly increased if directly compressible chewing gum excipient is available. Limitation of melting and freezing can be prevented by using these two methods. PHARMAGUM is example of the chewing which is made by the method. It is a mixture of polyol and sugars with a chewing gum base. Pharmagum is available in three forms namely S, M,C. Pharmagum M has approximately 50% more gum base when compared with pharmagum S. Pharmagum S contains gum base, mannitol and isomalt.<sup>3</sup>

#### Characterization of Medicated Chewing Gum

MCG's are visually inspected. Various physical properties are studied based on their solubility studies, relative humidity, colour and moisture absorption.

#### Weight Variation

Weight of 10 chewing gum is taken in one batch, then average weight is calculated. From this average weight, standard deviation is calculated.<sup>7</sup>

#### Physical Evaluation of Medicated Chewing Gum

All formulation were physically evaluated for following parameters like appearance, colour, stickiness, hardness, weight variation and plasticity.



**Hardness/Plasticity**

Monsanto type hardness tester is used for determination of hardness<sup>1</sup>.

**Stickiness**

MCG is placed on a plain surface, 250gm cylindrical hammer strikes on it for 10 min. Hammering frequency was about 30 per minute, stickiness is observed .<sup>1</sup>

**In vitro drug release studies**

Ph.Eur adopted an apparatus to determine the release rate from the chewing gum. Basic principle behind the apparatus is to simulate the chewing action on a piece of gum placed in a small chewing chamber by sample masticatory movement. Chewing chamber consists of known volume of buffer solution at a given temperature. Chewing rate and angle influences the drug release rate, that provide shear force to expose new gum surfaces.<sup>5</sup>

The transition from inactive gum to active dosage form is influenced by:

- ✓ Mechanical forces.
- ✓ Temperature.
- ✓ Wettability and water permeation.

Under sink conditions, the rate at which drug is released is directly proportional to the chewing frequenting and aqueous solubility of drug substance and is indirectly proportional to mass of gum base.

**Apparatus 1 – Chewing Gum Apparatus, Compendial-PhEur**

Apparatus for medicated chewing gum was adopted by Ph.Eur in 2000. It comprises chewing chamber, 2 horizontal pistons and a third vertical piston. The virtual piston works with two horizontal piston and keep the gum in right place between chews. Working procedure is described in Ph.Eur<sup>5</sup>.

**Apparatus 2 – Alternative Chewing Gum Apparatus**

Commercially available apparatus was designed by Wennergum. The chewing procedure contains

reciprocations of lower surface in combination with twisting movement of upper surface that provides masticatory action and also provide agitation of test medium. The upper jaw contains flat surface that is parallel to the middle part of the lower surface. The small brim of this lower surface is 45 degree angled upwards so this lower surface functions like small bowl. This bowl reduces the chewing gum from sliding during masticatory action<sup>5</sup>.

**CONCLUSION**

MCG's are excellent means of drug delivery systems as it is quite convenient for self-medication and administered without water. It has got great potential in the field of buccal drug delivery. Also, its wide spread use for smoking cessation increases its popularity. So, it is expected that in the coming years, the potential of MCGs will much more be explored.

**REFERENCES**

1. Ritesh kumar, pavitra Solanki, amrish Chandra; Medicated chewing gum- A novel drug delivery system, American journal of advanced drug delivery 2014;2(3):434-450.
2. Patel PV, Desai TR, Bandhiya HM, Medicated chewing gum a review, IJUPLS, 2011;1(1):111-128.
3. Jacobsen J, Christrup LL, Jensen NH. Medicated chewing gum. AM J Drug Deliv 2004; 2: 75-88.
4. Khanekar P, Nhatre S, Momin M. medicated chewing gum: a potential drug delivey system. IJPFR, 2012;2(4): 64-75.
5. Naik H, Gupta S. Medicated chewing gum- updated review. IJPRD 2011; 2 (8):66-76.
6. Shah KR, Mehta TA. Medicated chewing gum- A mobile oral drug delivery system. Int.J. Pharmtech Res.2014;6(1): 35-48.
7. Liberman HA, Lachman L, Schwartz JB, II edition, Pharmaceutical dosage forms, Tablets. IInd ed., 1990;1:367-415.

**Source of Support:** None declared.

**Conflict of Interest:** None declared.

For any question relates to this article, please reach us at: [editor@globalresearchonline.net](mailto:editor@globalresearchonline.net)

New manuscripts for publication can be submitted at: [submit@globalresearchonline.net](mailto:submit@globalresearchonline.net) and [submit\\_ijpsrr@rediffmail.com](mailto:submit_ijpsrr@rediffmail.com)

