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REVIEW ARTICLE

Medicated Chewing Gums: Recent Patents and Patented Technology Platforms

Prerna Kaushik[1] and Deepak Kaushik[1,*]

[1]*Department of Pharmaceutical Sciences, M.D. University, Rohtak-124001, India*

Abstract: The reason that the oral route attained such acceptance may be ascribed to its affluence of administration. Over the years, patient convenience- oriented exploration in the area of drug delivery has introduced potential innovative medicine delivery systems. The elegant drug delivery system is an amalgamation of science and dexterity with therapeutic prospect and presentability. It involves the administration of medications in a groundbreaking fashion with the assistance of cosmetics, wearable devices and oral drug delivery system which can also be used for ornamental purposes. Out of which, therapeutic chewing gum offers a highly suitable and amenable technique of dosing medications comprising children and elderlies. It is a potentially convenient means of administering medications either locally or systematically *via* the oral cavity. It bids innumerable gains over conventional drug delivery methods. Moreover, medicinal chewing gums involve the dynamic and constant masticatory actions for drug release. Currently, enriched expertise has made it promising to advance and fabricate medicated chewing gum with predefined properties and it could be a marketable triumph in the future. Apprehending this, several investigators and pharmaceutical companies are now engaged in developing innovative practices vis-à-vis medicated chewing gums by filing several patents in this area. The present manuscript also delivers a gestalt of various patented technology platforms based on different methods/mechanisms employed for the preparation of medicated chewing gums.

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1. INTRODUCTION

Although medicated chewing gum has an important potential to develop into a suitable alternative approach to mend patient compliance, it remains an arena that should be explored to the fullest. Chewing gum not only offers medical assistance but also a striking, distinct, and proficient drug delivery system [1]. Commonly, it takes a spell for a new drug delivery system to launch itself in the marketplace and gain support and fame by the patients, yet chewing gum is assumed to manifest its position as a favorable and strategic drug delivery system. It has high-quality values for the therapeutic industry and can be designed to acquire diverse release profiles of active constituents [2]. The mastication gum as a drug delivery system is beneficial, easy to administer anywhere, anytime and its agreeable taste increases product tolerability and patient acquiescence. With a mounting demand for alternative drug delivery systems and extensive knowledge of the product, a novel and consumer-friendly dosage form can be developed in the form of a medicated chewing gum [3, 4].

The right delivery system can significantly impact success by providing product distinctiveness in the market, as evidenced by nicotine gums. An innovative drug delivery system can provide additional benefits to the patient including a discrete and convenient administration, as well as the potential for buccal absorption, providing a rapid onset of action [5]. It can also provide new business opportunities for drugs approaching their patent expiry [6]. A periodical by Chaudhary and Shahiwala documented the latest alliances between Fertin (a market trailblazer in medicated chewing gum development situated in Denmark) and Generex Biotechnology™, converging on developing a metformin-containing gum for the management of diabetes [7]. Other instances comprise a functional gum containing *Hoodia gordonii,* a natural component that aids controlled weight loss by liberating a compound (P57), analogous to glucose, to stunt the craving in the hypothalamus. Table **1** designates the world wide marketed medicated chewing gums [8, 9]. Multiple corporations have made tactical investments in collective platform technologies to enhance the drug's safety and efficacy by a targeted methodology. In some illustrations, the convenience of patients is an imperative aspect. The deliberate aim is to formulate distinguished products that overcome the significant challenges of conventional

*Address correspondence to this author at the Faculty of Pharmaceutical Sciences, M.D. University, Rohtak-124001, India; Tel: +91-9315809626; E-mail: deepkaushik@rediffmail.com

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Table 1. Worldwide marketed medicated chewing gums.

Marketed Chewing Gum	Active Ingredient	Indication	Manufacturer
Nicorette®	Nicotine	Smoking Cessation	GlaxoSmithkline
Nicotinelle®	Nicotine	Smoking Cessation	Novartis Consumer Health
Chooz®	Calcium Carbonate	Stomach acid neutralization	Leosons Overseas Corporation, USA
Stay Alert®	Caffeine	Alertness	Stay Alert Safety Services,Inc
Fluorette®	Fluoride	Cariostatic	Fertin Pharma A/S
Vitaflo CHX®	Chlorhexidine	Preventing tooth decay	Fertin Pharma A/S
Travvel®	Dimenhydrinate	Motion sickness	Asta Medica

drug delivery systems and supplement importance to new products [10]. Experts and researchers also consider novel formulations for chewing gums to increase variants of chewing gum due to patients' unlike styles and providing suitable release pattern for the drugs which are contained in masticatory gums.

Important formulation aspects for medicated chewing gum include ion exchange resin complexation, which involves complexation of lipophilic active ingredients in ion exchange resins such as polacrillin potassium delivers continued drug delivery [11]. Also, this method is beneficial to disguise the flavor of bitter drugs. For concealing the taste, weak cation exchange or weak anion exchange resins are also used, depending on the nature of the drug [12]. Cyclodextrin complexes have been used to upsurge the solubility, stability, bioavailability and taste masking of a diversity of active constituents [13]. The mainly occurring cyclodextrins are α, β and γ types containing six, seven and eight glucopyranose units, respectively. They are used to enhance the aqueous solubility of poorly water- soluble drugs. Microencapsulation by water-soluble or water-insoluble polymer is one of the significant approaches for enhancing the release of the active ingredient, sweetener or flavorant from medicated chewing gum [14]. As evidenced by the number of patents and high-tech developments an endeavor has been made in the progress of more significant and adequate dosage forms which not only leads to improved patient compliance but also an eventual clinical output [15]. A few patents in this area are worth citing. The present article highlights the most innovative medicated chewing gum- based recent patents and also provides an overview of various patented chewing gum technology platforms. The all-inclusive records of the European patent office (http://ep.espacenet.com) and the United States patent office (www.uspto.gov) was engaged to assemble the patents and the patent claims [16, 17].

2. RECENT PATENTS ON MEDICATED CHEWING GUMS

Numerous techniques have been described in the academic and patent literature for countless products and processes involved in the medicated chewing gums. The restrictions of conventional techniques are provoking the researchers to ameliorate them, which results in several patents in the area of medicated chewing gum [18]. The antiquity of chewing gum ages back to the primordial Egypt and Mayan Indian eras when these folks used to masticate the dammar of trees. Medicated chewing gum became well-known as an advertised invention in 1869 when Dr. William F. Semple, a dentist by vocation filed the first patent for chewing gum. The first Medicated gum "Aspergum" was launched in 1928. This chewing gum is still accessible and comprises acetylsalicylic acid. Though, chewing gum did not gain recognition as a dependable drug delivery system until 1978, when nicotine gum became obtainable [19]. The notion of chewing gum for medicinal purposes provides a discrete method for delivery and does not highlight the illness or need for medication for the individual. It can also contribute to delivering on-demand medicines due to busy lifestyles. One of the most notable recent successes is nicotine replacement gums, which have greatly improved the acceptability of medicated gums.

The outmoded manufacturing method for chewing gums is the Conventional/ kettle fusion manufacturing method, which encompasses the use of a kettle mixer/ Z blade mixer which heats the gum base, ensuing in a phase change to the molten state for effective mixing. The excipients are added in steps and mixed for explicit periods to safeguard a consistent formulation. The active drug is usually amalgamated into the gum base at the start of the procedure before mixing with other excipients to ensure homogenous distribution throughout the samples [20]. The limitations are also linked with using subtle thermolabile actives as temperatures should be ample to soften the gum base throughout mixing [21]. The cost- effective technique of direct compression exploits free-flowing powders comprising a mixture of polyols, sugars, and gum base, which can be directly compacted on a traditional tableting machine, thus reducing manufacturing time and costs. An example is Pharmagum®, which is available in 3 forms including Pharmagum® M; which has a high gum base content, 50% more than Pharmagum® S; which comprises of a resin base and sorbitol and Pharmagum® C containing gum base, mannitol, and isomalt. However, gums molded using direct compression are normally harder and turn to crumbs during chewing, which may be disagreeable for the user [22]. The gums were formulated using a range of drugs including ranitidine, caffeine, and paracetamol and release were directly correlated with the drugs' physicochemical properties, specifically water solubility and also chewing efficiency and time [23]. The 3-layer gum model

was investigated further to include formulations containing fenoprofen calcium (100 mg) in the inner core (weighing 1.4 g) and maltodextrin in the two external sandwich layers (0.2 g). Optimized formulations contained freeze-dried complexes of the active ingredient with β-CD (1:1) and PVP as a water-soluble polymer to enhance release. An *in vivo* study found that relative bioavailability was increased compared to 200 mg commercial capsules (166.06%) and absorption rates were faster, presumably due to absorption *via* the buccal mucosa and avoidance of hepatic first- pass metabolism [24]. Thus, there is a need to reduce the active administered dose in gum formulations compared to conventional formulations [25]. Another method of formulation involves freezing, grinding and tableting of excipients. The gum base and excipients are maintained in a cool environment (typically 15°C or lower) until brittle, then the mixture is grounded and mixed with a fine powder. On warming to room temperature, the gum may self-adhere leaving minute air bubbles in the gum matrix. Alternatively, the powdered mix can be blended with additional excipients including binders and lubricants, and then compressed [26]. Below is the portrayal of some patents for therapeutic chewing gums containing various constituents like antacids, antihistamines, *etc*. Recently, a lot of work has been done describing the *in-vitro* release kinetics of exceptional dosage forms, including medicated chewing gums [27]. Due to the sophistication of the release mechanisms involved, the prediction of scholars remains insignificant concerning the site of release and absorption [28].

West *et al.,* developed chewing-gums, which were mainly valuable for treating gastroesophageal reflux disease. The chewing-gum preparation included a chewing-gum base and more than one component nominated from the collection containing an acid nullifying agent, an anti-gas agent, and an acid production inhibitor, and enviably all three constituents. Thus, a formulation was made which addressed the multifactorial etiology [29]. In a novel composition, Carsten *et al.* invented a tobacco alkaloid liberating chewing gum containing tobacco alkaloid, exudate base, elastomer, and resin-compounds. The objective of the creation was to accomplish a tobacco alkaloid release matching the release achieved when a user smoldered a cigarette [30]. Cherukuri *et al.* developed a mastication gum delivery system that has nicotine, a gum base, and a buffer system with a modified discharge rate for the nicotine. The ensuing delivery system gainfully provided an appropriate, steadfast, practical, and relatively trouble-free system for delivering an active ingredient [31, 32]. Nicotine chewing gum is presently accessible in the marketplace, either as 2 or 4 mg preparations. The gums discharge a meticulous quantity of nicotine in the mouth that is absorbed straight through the buccal mucosa, generating nicotine plasma concentrations that are quasi and produced by burning a cigarette [33]. The limitation of commercially accessible nicotine gums is their slow release and consequently, the slow beginning of the therapeutic effects. The unpleasant flavor of nicotine gums is, however, a key encounter concerning the patients' acceptance and amenability with suggested dose up regimens [34]. Thus, a study was carried out to formulate the gums using nicotine hydrogen tartrate due to its quick-release rate [35]. Nijhawan developed a stick of gum containing therapeutic benefits of non-steroid anti-inflammatory drugs, H2 antagonist (ranitidine, cimetidine, famotidine), and/or a proton pump inhibitor (such as lansoprazole, pantoprazole, omeprazole, esomeprazole or rabeprazole). The invention provided a composition capable of reducing the undesirable side effects resulting from NSAID administration [36]. One such chewing gum of Indomethacin was developed by Chatterjee *et al.* with an ambition to maximize the therapeutic benefits and curtail its reported side effects such as empty stomach acid secretion, abdominal cramp, diarrhea, water retention [37]. Norman *et al.* developed an innovative chewing gum in the form of a free-flowing particulate, which can be compacted at high speed by a standard tableting apparatus [38]. Bateddi *et al.* developed a composition for medicated chewing gums having the active principle dispersed in the gum and coated by a mixture consisting of a hydrosoluble element and a water-insoluble one. The tablet according to the invention, had high stability organoleptic properties, gradual and controlled release properties [39, 40]. Andersan *et al.* formulated chewing gums involving cyclodextrin complexation with one or more active compound(s) such as cetirizine. A serious problem encountered with the administration of these active compounds in an oral composition was the loss of stability which was observed during production and storage of the chewing gum. Therefore, attempts had been made to identify the reason for this loss of stability and find methods for counteracting the problem [41, 42]. In a recent patent, Cho *et al*. developed a chewing gum formulation comprising antihistamines, a gum base, sweetening agent, glidant, and a flavoring agent. Also, since the drug was provided in the form of chewing gum, side effects of antihistamines including somnolence and dryness of the mouth were alleviated by masticatory movements [43]. Recently Bachmann *et al.* developed an improved technique for the production of chewing gums that conserves the efficiency of the active ingredient(s) by avoiding exposure to high heat. A gum base was used, along with one or more therapeutically active constituents, one or more sweeteners (alcohol-based and/or natural), and one or more flavorings and optional taste modifiers. The method generally comprised heating the gum base in an oven to melt the gum base. Distinctly, the active ingredient(s), sweeteners and flavorings were combined in a blender. The liquefied gum base was added to the blender and cooled to produce a particulate combination. The coarse granules were mixed with tableting excipients at room temperature and tableted [44].

3. RECENT APPLICATIONS OF MEDICATED CHEWING GUMS

Chewing gum not only provides scientific benefits but also is an eye-catching, distinct and competent drug delivery system. Prospect of chewing gum will reveal all of the scientists' efforts for the development of chewing gum as a recent drug delivery system. In the future, other reports will be seen to formulate more drugs using chewing gum as a drug delivery system. Treatment of fungal diseases, prevention of caries, smoking cessation, long- lasting flavored, filled gums, timed-release are some of the trendy products to be seen in the future. Biodegradable chewing gums are also in demand these days [45, 46]. Abundant studies have revealed that taking chromium picolinate supplements as a piece of gum can curtail undue levels of insulin and make insulin receptors more receptive to its effects [47, 48]. Chewing gum can be

used in the management of minor pains, headaches, and muscular aches. Chewing gum formulation containing nicotine and lobeline has been clinically verified as an aid in smoking termination. Active ingredients like chromium, guaran, and caffeine have been proved to be proficient in handling obesity. Chromium is appealed to reduce hunger for food due to an upgraded blood-glucose balance. Caffeine and guaran excite the lipolysis and diminish the feeling of appetite. Xerostomia, allergy, motion sickness, acidity, cold and cough, diabetes, anxiety, *etc*. are all the suggestions for which chewing gum is a means of drug delivery [49-53]. Experimental trials, including patients with oral candidiasis have shown that miconazole chewing gum is at least as satisfactory as miconazole oral gel in the management of fungal infections in the mouth [54-57]. In a recent study, the stability of KSL-W, an antimicrobial decapeptide and it's potential as an antiplaque agent in a chewing gum formulation has been shown to obstruct the progress of oral bacterial strains related with plaque formation [58, 59]. Wamer-Chilcott Inc. developed Ovcon 35, a spearmint flavored chewable birth control gum [60]. Some of the recent applications of medicated chewing gum have been described below.

3.1. Tooth Whitening Property

The efforts to blanch teeth have a long past, thought to date back to the Ancient Egyptians. Over-the-counter products naturally contain carbamide peroxide or hydrogen peroxide as the bleaching agent. Chlorine dioxide is known to be a sterilizer, as well as a strong oxidizing agent. The bactericidal, algaecidal, fungicidal, bleaching and deodorizing properties of chlorine dioxide are also well known. These assets of chlorine dioxide have led to the development of a medicated chewing gum, which includes an active agent that is one of chlorine dioxide-generating components, a chlorine dioxide-containing solution, and their combinations [61-63].

3.2. Probiotic Gum

An extruded, center- filled or layered chewing gum has been developed consisting of probiotics such as *Lactobacillus acidophilus*, *Lactobacillus reuteri*, *Lactobacillus plantarum*, *Lactobacillus salvalarius*, *Lactobacillus sporogenes*, *Bi¦dobaterium longum*, *etc*. The probiotics conveyed to the oral cavity delivered an oral health benefit to the customer through the suppression of pathogenic bacteria [64, 65].

3.3. Psychospirituality

Psycho-spirituality" is defined as the study and practice of the mind's relationship with metaphysical, moral, and intrapersonal views. The invention related to a nutritious chewing gum consisting of the botanical plant *Salvia divinorum* which serves as a means for the arousal of human cognizance and mindfulness such that the overall psychospirituality is enhanced [66, 67].

3.4. Anesthetics

The invention related to the oral pain relief, and particularly to an anesthetic chewing gum to help assuage pain from orthodontic procedures. Tooth separation can have an unwanted impact on a patient's chewing, daily activity and sleep. The anesthetic chewing gum includes lidocaine and prilocaine hydrochloride as the anesthetic ingredients, as well as a chewing gum base [68].

3.5. Hypophosphatemia

The creation related to the non-medical use of a phosphorus compound in the chewing gum along with a binding agent chitosan, for reducing the level of free phosphorus in the digestive juice to alleviate hyperphosphatemia [69].

4. PATENTED TECHNOLOGY PLATFORMS FOR MEDICATED CHEWING GUMS

Platform know-how is considered a treasured tool to mend efficiency and quality in drug product development. The basic idea is that a platform, in amalgamation with a risk-based approach, is the most systematic method to leverage prior knowledge for a given technology. Moreover, chewing gum technology has been snowballing day by day thus numerous pharmaceutical and drug delivery syndicates are currently engaged in providing patented technologies. An innovative drug delivery platform generates supplementary patient welfares that will enhance new remunerations for a drug and, thus, preserve or upsurge revenue [70]. Following is a brief account of various patented technology platforms for a medicated chewing gum describing the underlying principle, advantages, and applications. Various commercial medicated chewing gum technology platforms are tabulated in Table **2**.

4.1. Medichew®

Medichew is a patented multi-layered compressed chewing gum technology developed by Fertin Pharma, Denmark [71]. The final product is powder-based containing the patented gum base, the active ingredient, sweeteners, savors, color, *etc*. The developing procedure is a straight compression tableting procedure likewise used in the development of traditional tablets and it is categorized as being dry and cool [72]. Some of the important advantages of Medichew® technology comprises that it is capable to separate active substances in diverse layers, can release diverse active ingredients at varying rates, long-lasting tang, apt for heat -sensitive active substances and has a meek built-up process [73]. AXIM is enthusiastically involved in the development of pioneering gum systems along with Medichew® technology to develop the cannabinoid-based constituents (Dronabinol) for the treatment of conditions, such as nausea and vomiting concomitant with chemotherapy [74, 75].

4.2. Skyepharma's®

Skyepharma's medicated chewing gum 'Geogum' [76] is appropriate for either local or systemic delivery of drugs. The patented medicinal gum expertise uses an approach similar to multilayer tableting. A mixture of layers controls the release rate of the active components and flavoring agents when the gum is munched. The active drug is released into the saliva for either local or systemic effects. The therapeutic chewing gum is patient welcoming and offers an ap-

Table 2. Commercial Medicated Chewing Gum Technology Platforms.

Technology Platform	Technology Basis	Commercial Product	Name and Address of the Company
Medichew®	Multi-layered compressed chewing gum	Energy 25, Caffeine (25 mg), Multivitgum, Svetol ™ (Diet gum), Cavity gum	Fertin pharma, Dandyvej 19 DK-7100 Vejle, Denmark
Rev7®	Environment- friendly polymer	Rev7® (Spearmint gum)	Revolymer®'Ltd Dock Road, Mostyn Flintshire CH89HE, UK
Health in Gum®	Powdered excipient directly compressible technology	Health in Gum® Garcinia Cambogia (200mg)	CAFOSA GUM SAU Av. Diagonal 474, 1ª 8ª 08006 Barcelona – Spain
Chewmed®	A cold and dry process, compressible powder under high pressure	Nico bright, nicotine gum (2, 4 mg)	Enorama pharma AB, Sodergaten 3, sec 21134 malmo, Sweden

propriate and discreet drug delivery solution. It is suitable for the delivery of medications that are metabolized by the gut wall or the liver, so circumventing the first- pass effect. This consents more swift delivery and enhanced bioavailability of the drug and, therefore the use of lesser doses**.** Similarly, it increases the bioavailability of poorly soluble drugs by enhancing their solubilization in saliva [77].

4.3. REV7®

Revolymer®, United Kingdom acknowledged problems related to the disposal of the waste material after chewing the gum. Revolymer® has developed a specific amphiphilic polymer Rev7™; when incorporated into a chewing gum base it can provide multifactorial benefits like augmented chewability, degradability, and removability of the substance [40]. It is composed of a polyisoprene backbone and grafts of Polyethylene Oxide (PEO) [78]. Chewing gum preparations by Behl incorporating lansoprazole were prepared by using Revolymer's® hydrophilic polymer Rev7, buffering excipients and complexed lansoprazole (with Mβ-CD, 1:1). The study focused on the issues related to the release of poorly soluble and unstable lansoprazole, from a medicinal chewing gum formulation. The improved preparation contained lansoprazole, 8% Rev7 and potassium carbonate to deliver the maximum release of drugs from the gum and also aided buccal absorption [79].

4.4. Pharmagum®

The development procedure can be fast-tracked if a directly compactable gum excipient is available. The limitations of melting & freezing can be overcome by using this skill. PHARMAGUM® is one such compressible gum method recognized by SPI Pharma [80]. Pharmagum is a blend of polyol(s) & or sugars with a chewing gum base. It is offered as a directly compressible and free-flowing powder that can be compressed into a gum tablet using conventional tablet press, thus allowing hasty and low budget development of a gum. It is manufactured under regulatory settings and complies with Food Chemicals Codex stipulations as well as with FDA, so they can be considered as "Generally Regarded as Safe" (GRAS). Pharmagum® is offered in three varieties namely S, M, and C. Pharmagum® M has 50% more gum base compared to Pharmagum® S. Pharmagum® S contains principally of the gum base and sorbitol. Pharmagum®M contains exudate base, mannitol & Isomalt. Preparations made with Pharmagum® M & S are similar to a tablet in appearance. Gums molded by compressible formulation are ten times stiffer and disintegrate when force is applied causing quicker release than conventional approaches [81]. Dextromethorphan hydrobromide chewing gum formulations were made by Swamy *et al.,* using Pharmagum M as a base with an ambition to overcome the first pass outcome and for attaining quicker systemic absorption. It was then converted into a spray- dried form and combined with Pharmagum M base with the aim of solubility improvement and hiding the acrimonious taste of the drug [82].

4.5. Health in Gum®

Cafosa's Health in Gum® powdered excipient is a unique, special system that empowers to develop compressed chewing gum [83]. The Health in Gum® powdered excipient is a directly compressible powdered gum that contains a mix of basic ingredients ready to add to the active ingredient. Health in Gum® is so attractive that it consents to produce an extensive diversity of compressed products. Various benefits include:

- It does not necessitate precise chewing-gum production equipment.
- It performs brilliantly using standard tableting equipment.
- It has exceptional flow and easy to tablet.
- It has faster drug release profiles compared to traditional gum due to the bonding of drugs to gum base.
- It works at room temperature, permitting the use of thermolabile drugs.
- It is ideal for water-sensitive drugs.

Other benefits include patient compliance, fast commencement of the action, reduced side effects, *etc*. [84]. It is also available in three varieties HIG 01, 02 and 03. HIG 01 and HIG 02 have similar composition *i.e*. gum base, sorbitol, xylitol, coating agent and plasticizer; the only change is that amount of gum base in HIG 02 is marginally more than HIG 01. HIG 03 contains a greater proportion of gum base than HIG 01 and 02 and also holds isomalt, sorbitol and anticak-

ing agent [85]. Paradkar *et al.* developed a directly compressible chewing gum of Dextromethorphan incorporating Health in Gum® with amended taste by using a blend of the sweeteners [86]. A study by Chaudhary *et al.* was based on the theory that cetirizine as a BCS class I drug will be released from chewing gum and can be easily pervaded from oral mucosa and absorbed into systemic circulation without producing drowsiness as a common side effect [87].

4.6. ChewMed®

Enorama Pharma employs a modern technology platform, the ChewMed® technology, which is well matched for the fabrication of medicated chewing gums. The ChewMed® technology licenses to produce gums from a dry gum powder under high pressure and low temperature.

The gum has modified sensory properties compared to other gums, making it as worthy as confectionary gums. The added feature is the crusty coating, which results in a remarkably energizing taste sense when chewed upon. The ChewMed® platform offers a sole opportunity to assess different drugs and their appropriateness for administration *via* gums. The benefits of the Enorama Pharma chewing gum are superior ability to carry different drugs, improved and longer taste, range of flavors, crunchy coating, attractive appearance and pronounced potential for manifold applications [88].

CONCLUSION

Chewing gum not only offers clinical benefits but also is an attractive, distinct and efficient drug delivery system. Clinical trials have confirmed the advantages to be gained by exploiting the effects of chewing gum, the convenience of the delivery and the possibilities of buccal absorption and local effect. The present manuscript delivers numerous innovative patented applications employed in the field of medicated chewing gums. Management of fungal diseases, prevention of caries, smoking cessation, biodegradable gums, birth control gums, probiotic gums, nutrition supplements and anesthetic gums are some of the trendy products to be seen in the near future. The article further provides an insight into various commercial platform technologies used for medicated chewing gums. With the beginning of new innovative applications and commercial technology platforms, the area of medicated chewing gums will continue to appeal the consumers.

CURRENT AND FUTURE DEVELOPMENTS

Chewing gum as a medication delivery system has presently gained widespread approval within smoking termination and oral healthcare, a vast curiosity of its other indications subsists and endures to grow. Since the active material will be released in the oral cavity and persist there for an extended period, unique skill in taste modification are essential to the triumph of a medical chewing gum product [89]. Antihistamines, appetite suppressants, expectorants, antitussives, nasal decongestants, analgesics, antipyretics, anti-inflammatories, electrolyte and mineral supplements, antacids, laxatives, vitamins, are the utmost potential conceivable targets for delivery in the form of chewing gum due to its higher patient agreement and quick onset of action [90]. Furthermore, one trial has specified that the chewing gum is perhaps a harmless drug delivery system for the drugs that are vulnerable to abuse. In the coming years, innovative preparations will enter the marketplace and chewing gum will become a much more public drug delivery system. In this review, the authors have concentrated on describing pioneering medicated chewing gum technology platforms and some cutting-edge patents [91]. The most frequently commercial technology platforms include multi- layered compressed chewing gum, environment - friendly polymer, powdered excipient directly compressible technology, a cold and dry process utilizing compressible powder under high pressure [92]. The future research on medicated chewing gum will center on exploring the novel gum base preparations that are compactable, digestible and potentially recyclable but the impact of these bases on drug release must be fully inspected. With the arrival of novel pioneering technologies and commercial technology platforms, the area of medicated gums will linger to appeal both academicians and therapeutic enterprises and the future for gums look perkier than ever [93].

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