

Improper Disposal of Non-biodegradable Chewing Gum is One of the Biggest Threats to Our Ecology: A Review

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Abstract

One of the oldest habits of human beings is chewing gum. It has continued from ancient civilizations to the current time. Gum chewing provides a relaxing experience that individuals enjoy for a long time. The non-food item, chewing gum, has a long history. The gradual progression of its development has provided us with a greater flavour as well as extra medicinal properties. Chewing gum is known for its stress-relieving qualities as well as its ability to keep our mouth fresh. Soon, 'chewing gum' will be included as part of the drug delivery mechanism. Unfortunately, it has had some negative consequences. Modern chewing gum is made of non-biodegradable hydrophobic polymers together with artificial sweeteners and flavours. So, chewing this sort of synthetic material over a long time could produce some adverse effects. After chewing, most individuals throw the waste part of chewing gum everywhere, resulting in environmental trash known as 'gum pollution'. Each year, chewing gum generates more than 10^5 tonnes of "plastic" garbage. Thus, the discarded non-biodegradable residue of the gum produces 'plastic pollution'. Every year, enormous sums of money are spent to clean up the abandoned gum from the streets. Again, it has a high potential to trap bacteria inside. Therefore, this widespread habit causes an additional nuisance in this pandemic situation. As a result, the waste part of the gum has multiple dimensions to pollute our environment. Gum disposal has become a major problem all across the world. Gum litter can only be reduced by properly disposing of gum. As a result, it's time to reconsider the role of chewing gum in terms of human health and the environment. This article emphasises the importance of proper waste (gum) disposal and calls for increased awareness to safeguard our environment from "gum pollution."



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Introduction

Gum chewing is a popular activity that we tend to do merely for pleasure. Teenagers are enjoying chewing gum and blowing bubbles with it.¹ Besides the bubble-blowing, young girls and boys alike relish peeling the gum off their faces. Gum is extremely popular among people of all ages throughout the world. Gum is chewed by people all around the world to relieve stress.^{2,5} As a result, we regularly see that our favourite athletes chew gum to keep their tensions and emotions in check while playing. Others might chew gum to keep their teeth white, breathe fresh, or for oral care.³ Examinees chew gum to beat the stress of the associate examination. Some people take it as a substitute for smoking or to get a caffeine energy boost.^{4,5} Several scientific studies have found that medicated chewing gum improves oral benefits and, as a result, may be used as part of a drug delivery system.^{6,7,8}

The art of gum chewing is the world's most common habit. Its allure is passed down from generation to generation. Recently, archaeologists have confirmed that this habit is nearly 9,000 years old.⁹ Surprisingly, evidence suggests that a caveman teenager chewed a piece of tree resin on the Swedish island of Orust. So, chewing gum has a long history.¹⁰ Interestingly, astronauts also chew gum! But for them, the problem is how to dispose of it?

Besides this fascinating fact, gum chewing has many adverse effects. Modern chewing gum is composed of synthetic non-biodegradable polymer materials along with artificial sweeteners and flavours. Thus, during the chewing, the mixtures of elastomers, polymers, resins, and paraffin will mix with the saliva for a long time. So, chewing a polymer-based substance over a long time might not be considered a healthy practice. It will create a health-related problem directly or indirectly.

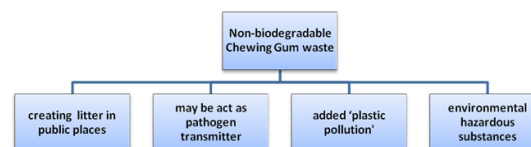
After chewing, gum waste must be spat out and cannot be swallowed. So, the biggest problem regarding chewing gum is how we will dispose of it? Unfortunately, most of the time, after chewing, people dispose of it improperly. In most cases, a fan of "chewing gum" will throw waste parts on the pavement or here and there. As a result, discarded chewing gums were found underneath a chair, table, and roadside pavement for a long time. Historically important sculptures and artworks are also affected

by the irresponsible attitude of gum lovers' tourists. It is the second most common form of litter in public places, after cigarette butts.^{11,12} Thus, the gum will increase a significant amount of non-biodegradable waste. Removing pasted "chewed gum" from the pavement and any other surface is a laborious, costly, and time-consuming process.

The global market for chewing gum has sharply increasing. In the year 2019, the revenue of the chewing gum market will reach more than 37 billion U.S. dollars. Market analysts predict that the global market for gum will rise at an approximate rate of 6.5% and total revenues will reach 46 billion U.S. dollars by 2025.^{13,14} The leading market for gum is found in the Asia/Pacific region, followed by Western Europe, based on the amount of gum sold per region. More than 60% of teenagers and adults in Europe chew gum every day. On average, they consume 1 to 4 pieces of gum per day.^{13,15} While in Saudi Arabia and Iran, 80% of the population chews gum regularly.¹⁶ The same trend is following 46% of the people of the United Kingdom.¹⁷ So, we can imagine the amount of wasted chewing gum per day piled up in nature! Chewing gum adds more than 10⁵ tonnes of "plastic" waste each year.¹²

Oral germs may be trapped in discarded chewing gums, according to the experimental result published by Satari L. *et al.*¹⁵ Thus, non-biodegradable chew gum waste that has been incorrectly disposed of could be operating as a bacterium transmission medium. There is yet no scientific research on this subject. More research is needed to fully understand this fact. The risk that arises from chewing gum can be expressed as the function of the two factors: f (hazardous intrinsic composition, exposure of its waste portion to the environment). Gum waste components are multifaceted environmental danger substances (see chart-1 below).

Chart-1



We are not opposed to the sale or prohibition of chewing gum. We oppose the annoyance of producing gum trash due to environmental concerns.

So far, a few blogs or articles regarding "gum pollution" have appeared in print or electronic media at various periods, but to my knowledge, there isn't a single systematic review article on the subject. The perspective on waste (gum) disposal and its many environmental implications has been covered in this article. Gums that have been improperly disposed of have a silent effect on the environment. We are confident that our review article will address the issue and raise reader concerns about chew gum disposal. It's time to figure out how to do things properly.

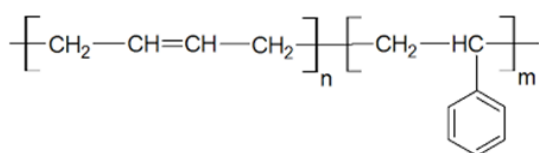


Fig .1: Butadiene (CH₂CH=CHCH₂)-styrene(C₆H₅CHCH₂) copolymer linkage

What is Chewing Gum?

Chewing gum is a rubbery substance that has been flavoured and sweetened artificially. It's actually a sugar-and-flavour-coated polymeric substance. It is elastic-plastic, sticky, and chewy in characteristics.¹⁸ Previously, natural rubber was used for gum preparation. But the modern gum base is radically shifted to synthetic polymeric substances such as butadiene-styrene-based rubber or isobutylene-isoprene copolymer (butyl rubber).^{19, 20} These polymers are also employed in the production of automobile tyres. Chewing gum and wheel tyres both have the same backbone in terms of composition. It's unsurprising that the majority of people have no idea what they're chewing on. Because the chewing gum manufacturers don't disclose all the details about it. Gum is fundamentally a lump of non-biodegradable, non-recyclable malleable plastic and that's sticky by nature. Chemicals present in the core of the gum are flavouring substances, sweeteners, food colourings, preservatives and polymer gum base.

Historical Background of Chewing Gum

With the technological advancement and cultural tradition, the standard of gum composition has been improved a lot. Ancient person used tree resin lumps, sweet grasses, leaves, grains, and waxes as chewing substances. Ancient Greeks chewed mastic gum made of mastic tree resin. The word "mastic" means 'gum' with medical values like inhibitor and antifungal properties.^{21,22} It can also shield the

teeth from decay, periodontal disease, and oral microorganisms. The traditional Mayans chewed the coagulated sap of the sapodilla tree. They additionally used a natural tree gum named chicle gum. Ancient Americans had a history of chewing spruce resin. In 1848, the first commercial form of chewing gum was invented by John Bacon Curtis. It is known as the State of Maine Pure Spruce Gum.²³ William Finley Semple filed and received patent for the commercial manufacturing for chewing gum in 1869. In the 1950s, sugarless chewing gum was available on the market. Dr. Petrusis, a dentist, was the first one to give the idea of sugar-free chewing gum. Some dentists approve gum containing ammonia to neutralise the acidic effect of bacteria to protect against tooth decay. Finishing off 1960, they presented the first sugar-free bubble gum called Blammo.²¹

Manufacturing process of Chewing Gum²⁴

Commercially prepared chewing gum started in the late nineteenth century in America. Nowadays, the complete method goes through automatic.² The basic steps for the preparation of the gum base are shown in Figure 2.

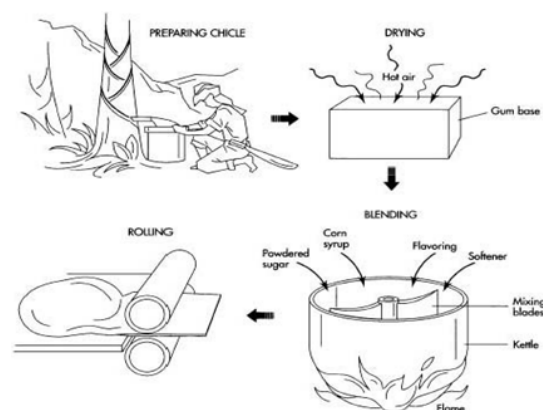


Fig .2:Steps in chewing gum preparation²⁴

Step 1: Natural gum base such as chicle, collected from chicle trees, into a bucket. After a significant amount of chicle is collected, it is strained and boiled to concentrate. Step 2: The natural or synthetic gum base is ground to form a coarse meal. Then the mixture is dried for a day or two by passing hot air. Step 3: Sterilize and melt the mixture in extremely steamed cookware. Then it passes through a high-power centrifuge to eliminate unwanted dirt from the gum base. Later on, the gum base ingredients

melt until the formation of the thick liquid mixture is obtained. After being filtered, the liquid mixture is heated to around 115°C, and then it will turn into thick syrup. Step 4: In this stage, in hot conditions, aldohexose syrup, softeners, and flavour additives are added. Step 5: For several hours, machines "knead" the mass of chewing gum until it is smooth and rubbery. Step 6: After that, a computerised cutting machine cuts it into specific forms as needed, which become candy-coated later. Then the wrapper machine will wrap and pack the gum.^{2, 24}

Chewing Gum Ingredients

Before 1850, traditional gum was made by natural latexes like chile, jelutong, gutta-percha, resin or mastic gum, etc., but the modern variety of gum is completely synthetic base.¹⁴ Current chewing gum makers exchange natural latex with artificial substitutes. Today, all multinational companies are using synthetic chemical materials that are helpful to boost flavour, improve texture, and reduce the stickiness of gum. Due to the hydrophobic nature of synthetic polymers, gum cannot dissolve in the saliva of the mouth or stomach acids. Polyvinyl acetate, synthetic elastomers, sweeteners, antioxidants, colour and organic acid are the key ingredients of gum.

Property of Chewing Gum and the Chemistry Behind It

The recipe for each variety of gum is different. However, for all types of gums, there are some common types of features. The properties of the gum and possible scientific explanation behind it will be shortly discussed in this section. To analyse the impact of the chemicals employed in the gum, it is necessary to understand the chemistry underlying them.

Chewiness

Gum's primary prerequisite is chewiness. For this reason, polymer-based ingredients are employed to create a 'gum base.' Polymers are long-chain compounds that are insoluble in water and therefore hydrophobic in nature.^{14, 24} On the other hand, the hydrophilic sugar part of the gum dissolves in the saliva of the mouth. Gum lost its flavour with time. This mechanism will help chewing gum for a long time without it breaking down as it becomes non-chewable. In chewing gum, ingredients are soluble in two different phases as a liquid phase and a

crystalline phase. It helps to maintain the balance of their unique plastic and elastic properties. It also helps to convert gum from being rigid to squishy after a couple of rounds of mastication.

Stickiness

The sticky behaviour of hydrophobic polymeric materials is one of their unique characteristics. It adheres to the surface easily and is tough to remove because to its stickiness. When we try to remove a piece of gum from a surface, we utilise most of our force to stretch the polymeric linkage rather than break the surface-to-gum bond. The presence of polymeric linkage is responsible for the gum's flexibility and chewiness. As the repeating monomer units elongate and shrink due to an applied external stress, the polymeric chain between them remains intact. Temperature, saliva, and grinding of human teeth all affect the flexibility and adhesiveness of gums while chewing. Because the degree of alignment in the polymeric chain is a function of the magnitude of applied stresses, chewing gum retains its elasticity over time.²⁴ The polymer chain is hardened when the gum is exposed to a cold environment.

Capability to Blow Bubble

Most chewing gum lovers are interested in blowing bubbles. It is produced when the tension and elasticity of the gum polymers act against the constant and equal air pressure blow from the mouth. Such bubbles are naturally of the spherical type due to the following rules of physics: The gum polymer can stretch, expand, and become thinner with increasing air pressure. When the excess air pressure is not tolerated by the gum polymer, it pops. The flattened bubble withdrawals due to their elastic nature and the wad of gum are ready to continue being chewed. The polymer's higher molecular weight allows it to stretch, increase bubble volume, and hold its shape for a longer period of time.^{24, 25}

Flavour Introduction

The release of flavour slowly after chewing for an extended time attracted the youngsters. Chewing gum in a variety of flavours is available on the market. Several thermodynamic parameters operate to release flavour during mastication. The effects of entropy play a crucial role in the mastication process. The sugar part of the gum is soluble in saliva within the initial first three to four minutes of chewing. After

4-5 minutes of mastication, intense sweeteners and some acids are dissolved and released. Within 10-15 minutes, the encapsulated flavours will release. At the end of chewing, the syrup and glycerine-like softeners dissolve with saliva and harden the gum. Several studies show that the gum flavour is perceived better in the presence of a sweetener. Currently, gum makers are trying to design unique gum which will facilitate getting pleasure from chewiness in conjunction with long-lasting flavour.²⁷

Feeling of Coolness

The negative enthalpy of dissolution of bulk sweeteners like sugar alcohol functions to urge the cooling sensation. During this mastication, overall heat will either absorb or discharge throughout the desolvation method. During this process, bulk sweeteners will absorb the heat and create the negative enthalpy of the system, leading to the cooling sensation.²⁸

Softeners

Glycerine and vegetable oil are commonly used as softeners in chewing gum. These components help to keep gums moist and prevent them from hardening.²⁸

Gum Chewing and Health Issues

Health Advantages of Gum Chewing

Chewing gum is beneficial to oral health, particularly for teeth; according to several studies reveal this facts.^{29, 30, 31} Sugar-free gum boosts secretion, which is important for oral health and cavity protection. The secretion of excess saliva employs a high concentration of buffers, minerals, and antibacterial substances. As a result, these aid in the removal of sugar, foods, and decay-causing acids, as well as the protection of tooth enamel from bacterial attack. Survey reports say sugar-free gum chewers have fewer cavities than others and also help to quit smoking. This sugar-free gum, when chewed for 20 minutes after meals, acts as a decay preventer, mouth cleaner, and mouth freshener.

The Negative Effects of Gum Chewing

Chewing gum is a butadiene-styrene or isobutylene-isoprene copolymer-based rubber material. Artificial food colourings, preservatives, artificial flavouring substances and sweeteners turn it into a delightful chewable matter. It has been reported that gum

chewing for a long time can activate tension in the jaw and trigger Temporomandibular Joint Disorder (TMD).³⁵ Gum chewing might cause gastrointestinal issues. Gum can considerably trap oral germs, confirmed according to the recent studies.^{15,32} Artificial sucrose used in the gums can be metabolised by oral bacteria (*S. mutans* and *Lactobacillus* spp.), which can demineralise the enamel and cause dental cavities, according to a document issued by the American Dental Association (ADA).^{36, 37}

Non-Biodegradable & Harmful To The Environment

A hydrophobic substance repels polar molecules while attracting non-polar things like grease and dirt, while a hydrophilic substance attracts polar molecules and repelling non-polar substances like grease and dirt.

Gum is prepared by a mixer of chemicals that are both hydrophobic and hydrophilic in nature. 'Amphiphilic' substance refers to various forms (like gum) that have both hydrophobic and hydrophilic characteristics.³⁸ The chewing gum trash is so firmly attached to the concrete and other surfaces that it is quite impossible to remove them with any cleaning solution. It occurs as a result of the gum's physical characteristics. As a result, incorrect gum disposal results in "gum pollution" or "gum litter." One of the drawbacks of synthetic polymeric materials is their non-biodegradable nature.^{39, 40}

Non-biodegradable materials, such as plastics, including chewing gum, do not disintegrate naturally and result in plastic waste.^{41, 42} One of the most serious challenges to our environment nowadays is to reduce the amount of plastic waste. After inadvertently ingesting plastic garbage, several fish and marine creatures have developed serious health problems. If we consume this plastic, which contaminates deadly fish or marine organisms, there's a high chance that we'll get poisoned. Every day, non-biodegradable, non-recyclable used plastic products pollute our environment in various ways. As a result, our ecological balance is disrupted. Plastics and synthetic rubbers have a long life span. As a result, when individuals discard chewing gum on the roadway or elsewhere, it persists there for the next 90-100 years. As a result, discarded gum is

a noxious substance in the environment. Reducing the usage of non-biodegradable plastic is a huge challenge for us.^{39, 40}

Chewing Gum Waste Is A Part of 'Plastic Pollution'

Every day, we generate tonnes of plastic waste across the globe for domestic and industrial reasons. Plastic pollution has become a grave threat and a serious issue that demands immediate attention and prompt action. In 1950, only 2 million tonnes of plastic were produced globally. However, global plastic production increased nearly 200-fold in 2015, reaching nearly 381 million tonnes per year.^{41, 42} Out of this, only 20 per cent of plastic materials are recyclable. That means the rest of the non-recyclable plastic waste is dumped into the ocean and builds a vast wasteland inside. The concerning thing is that these plastics require hundreds of years to degrade. For example, a plastic bottle needs almost 450 years to bio-degrade! It has been predicted that by 2025, global urban residents will generate more than 6 million tonnes of solid waste daily.⁴³ By 2035, India will be the leading producer of plastic waste, producing approximately 46.3 million tonnes per year, followed by China.⁴⁴ The packaging business accounts for 42 percent of total plastic waste when compared to other industries.⁴³ All non-recyclable plastic items, from Styrofoam cups for drinking water to plastic wrappers around candy, are ultimately converted to plastic waste. In this regard, single-use microplastic (5 nm in size dimension) is a huge annoyance.

At present, chewing gum contributes to 100K tonnes of plastic waste every year. Imagine, these amounts of E-waste are produced in the UK each year! In the coming year, gum pollution as a part of plastic pollution also increases as global chewing gum markets expand rapidly. So it is clear that gum-waste not only litters but also creates unwanted 'plastic pollution'. Plastic pollution is a tremendous environmental hazard that demands concerted efforts to protect our environment. Rocham *et al.* extensively studied and published the ecological impacts of marine plastic on marine species.⁴⁵ Their study concluded that wasted plastic debris imbalanced our marine ecology.

The Effects of Plastic Pollution at A Glance

plastic waste has been identified as having a negative impact on over 660 different marine organisms, ranging from fish to zooplanktons.⁴⁶

the absorption of microplastics in seawater at lower concentrations increases the hydrophobic pollutants.
destroys the marine ecological balance gradually.^{43, 47, 48}

causing local flooding by clogging drains and lowering air quality due to open dumps.

In addition, the burning of plastic materials can release harmful toxins that decrease the standard of air quality and causes respiratory problems.

Chewing Gum is A Big Litter Issue Can Result In an Embarrassing Situation

Chewing gum is a sticky substance. Gum trash is typically dumped beneath benches, tables, railings, and escalators. Chewing gum adheres to lyophilic surfaces like asphalt and rubber shoe soles. Once it has "walked in" and dried, it becomes a laborious task to remove. When discarded gum becomes stuck on our clothes and shoes, it may be quite embarrassing for us.⁵⁰

Common Littering Objects in Public Places

In the streets and sidewalks, gum establishes a strong bond with the concrete. On the pavement, it generates a 'plague'.⁵¹ Gum littering is a common occurrence that we've observed on city streets, at schools, colleges, offices, parks, and other public spaces. It has been observed that more than 92% of Britain's town paving stones are marked by millions of black or white spots due to trapped gums^{51,52} (Figure 3). During the 2012 Olympics in London, organisers removed about 300,000 pieces of gum from two miles of streets. This information aids in understanding the issue of gum littering in public places.

Expensive Cleanup

According to a survey report from the year 2000, almost 250,000 blobs of gum were smeared on Oxford Street alone. In 2015, it was predicted that local authorities in the United Kingdom spent about

70 million euros cleaning up chewing gum from the streets.⁵² According to some surveys, it is the second most frequent type of trash after cigarette butts.⁵⁰ Chewing gum will produce about one million tonnes of huge garbage in the next five years.¹³ Because chewing gum is getting more popular, more gum waste is accumulating in nature. Removing sticky gum from city streets or even historic landmarks

is costly and time-consuming task. A report says that in Rome, 15,000 pieces of chewed gum are discarded daily.⁵⁴ Cleaning companies are charged one euro per piece of pasted gum removed from the pavement. Thus, millions of dollars are wasted each year trying to reduce gum litter and fund cleanup programs.



Fig.3: (Left) Map of Great Britain & (right) patch of chewing gum on London Street²⁴

Affects Aesthetic Value and Local Tourism

Gum residue is applied on the surfaces of archaeological heritage monuments and priceless artwork by some reckless people. It will degrade the artwork's heritage temperament and cultural value, as well as cause visual pollution.^{15, 55} Tourists avoid trash places because of the unsanitary conditions and ugliness. As a result, it has an impact on the local population's economic situation. Gum littering has become a global issue, with only a few governments taking the required steps to combat it. For example, the Singapore government has previously made chewing gum illegal in order to keep the streets free of gum.⁵⁶ In 2004, the Singapore government lifted the restriction and allowed sugarless gum for medical reasons.⁵⁷

The gum is fully combined with saliva during mastication. As a result, chewing gum residue is always associated with the chewer's saliva. Using culture-dependent and independent approaches, Satari *et al.* and their group establish the presence of oral bacteria in discarded gum samples is not uncertain.¹⁵ So, it can be a transmitter of infectious diseases if an infected person throughout irresponsibly to its environment. In this pandemic

situation, everyone has the responsibility to resist the spreading of coronavirus. Due to this fact, in this 'new normal' situation, any discarded chewable substances can multiply the spread of pathogenic microorganisms.^{15,32,58} Not only can that happen, but discarded chewing gum on the pavement can also infect sanitation workers. Many state governments and associations take safety precautions in these conditions. They have imposed a complete ban on the sale of gum during this pandemic situation. However, no scientific analysis is available that pathogen can spread through discarded chewing or bubble gum. It remains a topic of future research projects. In this pandemic situation, spitting in a public place is an offence. Hence, spitting off chewing gum on roads should be taken as a punishable offence. Otherwise, it could potentially propagate infectious diseases.

Possible Solutions of Gum Disposal

Educated People Specially Children and Youth

Education is the most important factor in reducing littering. Almost every child and young adolescent enjoy chewing gum. This instruction should start in the classroom. As a result, changing their behaviour can help to solve the gum-littering problem. Children

are excellent learners and may be able to persuade their parents to refrain from littering. When the youngsters are old enough to recognise the littering problem, they should take appropriate steps to reduce it. People need to understand how their daily activities affect the environment. It is simple to avoid littering if people adjust their attitudes and take responsibility for environmental protection.

Anti-Litter Campaigns

It is our social responsibility to properly dispose of the gum trash. Chewing gum companies and local governments must have a social duty to educate the public about proper gum disposal. To clarify the multiple impacts of the gum litter problem, continuous campaigns in digital and print media are required. As a result, before dumping chewing gum on the pavement or other surfaces, people should think twice. Gum lovers should use a wrapper to surround the eaten chewing gum and dispose of it at the nearest public bins. To build a successful "clean gum" project, every gum consumer should step up.

Putting Up Litter Bins

Recently British company 'Gumdrop' placed several specially designed Gumdrop bins⁵⁹ (Fig. 4) in public places. Gum lovers should drop the gum waste into this specified bin. Gum disposal becomes easy enough if sufficient gumdrop bins are placed in public places, amusement parks, playgrounds, walking route and airport areas.



Fig .4:Gumdrop bins⁶⁰

Recycling of Waste

It's quite exciting that a few companies, such as Gumdrop Company, have just started recycling leftover gum into various items and marketing them. It's a wonderful initiative to recycle waste materials and turn them into useful stuff. This recycling project benefits both the local community and the surrounding area. Terracycle, a new Jersey-based recycle Company, is working on a project to recycle gum into accessories in America, Mexico, and the United Kingdom.

Future Prospects

Gum littering has become a major problem in every country. As a result, the civic authorities must pay attention to it. Several methods have been used to remove discarded gum off the surface, including blowing steam or chemicals onto the gum, freezing the sticky lump with liquid nitrogen, or scraping it off by hand. All of these are costly and time-consuming processes.

Recently, numerous manufacturing companies are trying to work with 'amphiphilic' polymers to make "low-adhesion" environmentally friendly chewing gum.^{61, 62} The University of Bristol and the British company Revolymer⁶³ have developed a polymer-based gum named Rev7. Revolymer claims that it is a bio-degradable gum and is composed of polyisoprene and poly (ethylene oxide) materials. This advanced technology-based gum will help to save millions of dollars in clean-up costs and erase the gum-littering issue.

Methodology

This review is based on the facts and findings of multiple manuscripts/electronically available documents, as well as various scientific research publications on the topics of "chewing gum," "gum pollution," "plastic pollution," and related issues that may be found in electronic database searches.

Conclusion

Modern chewing gum is a synthetic hydrophobic polymer-based substance coated with artificial sweeteners and flavour. People chewed it to refresh their minds. Medicated gum is now commonly used for oral hygiene. In the future, it becomes part of the drug delivery system. It is, by nature, non-biodegradable and sticky. If you chew gum on a daily basis, unfortunately, it might cause gastrointestinal issues, tooth decay, and muscle dysfunction. Most

people dump it on various surfaces in public areas after chewing it. As a result, abandoned chewing gum stayed there for a long time and became "gum litter". It will eventually turn into an environmental hazard and will worsen over time. Gum's popularity is rapidly growing all around the world. In the next five years, more than one million tonnes of chewing gum will be accessible on the market, suggested by gum market analyst. So you can imagine how much 'plastic pollution' will bring gum waste to the environment in the coming years. Large sums of money are spent each year trying to remove thrown gum from the pavement. Gum littering harms our health and the environment both directly and indirectly. The issue of gum littering and its subsequent impact on our ecology is the focus of this review paper. People's reckless attitudes can greatly increase "gum pollution," i.e., plastic pollution. Gum-littering can only be reduced if awareness build up and a shift in our long-term attitudes. Gum makers and municipal governments need to take more responsible steps to educate the public about safe gum disposal. "Zero waste gum," on the other hand, can only be achieved if a less sticky, water-soluble,

biodegradable gum is substituted. We have high hopes. Researchers in this field take the challenge of preparing bio-degradable gum that also retains the pleasure of gum chewing. This research article opens up a new outlook on the 'neglected problem' of waste gum disposal and alerts all concerned to take immediate action to protect our environment. Any kind of littering is a dangerous activity and should be taken seriously because it ruins our environment in different ways.

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Conflict of Interest

The authors declare no conflict of interest.

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