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Futuristic Progress of Natural Emulsifiers in the Enhancement of Drug Delievery System and their Applications in Selected Medical Therapeutics

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Abstract

Food manufacturers are being encouraged to employ more natural and sustainable food components as a result of consumer concerns about human and environmental health. Synthetic components are being replaced with natural ingredients, while animal-based ingredients are being replaced with plant-based elements. Phospholipids, biosurfactants, proteins, polysaccharides, and natural colloidal particles are some of the natural emulsifiers that might be used in the food sector. Natural emulsifiers may be used more frequently in food items, resulting in a healthier and more sustainable food supply. More study is needed, however, to find, isolate, and characterize novel sources of economically viable natural emulsifiers suited for food applications. Foods, cosmetics, detergents, and personal care items are among the commercial products that are under increasing consumer demand to be more natural, sustainable, and ecologically friendly. As a result, the industry has attempted to develop natural alternatives to synthetic functional components in these goods. Natural emulsifiers such as amphiphilic proteins, polysaccharides, biosurfactants, phospholipids, and bioparticles are being used to replace synthetic surfactants. The physicochemical foundation of emulsion generation and stability by natural emulsifiers is explored in depth, as well as the benefits and limits of various natural emulsifiers. Single emulsions, such as water-in-oil and oil-in-water, and multiple emulsions, such as water-in-oil-in-water, are the most common types of emulsions. Emulsifier / emulgent is a chemical that increases the kinetic energy of an emulsion to stabilise it. Emulsifiers are separated into four types based on their chemical structure: synthetic, natural, finely split solids, and auxiliary agents; and three types based on their mode of action: monomolecular films, multimolecular films, and solid particle films. Surface tension theory, surface orientation theory, and plastic/interfacial film theory are some of the ideas that aid in the understanding of the emulsification process. emulsion, natural emulsifiers, biosurfactants, emulsion technology, water-in-oil.

Keywords: Emulsion; Natural emulsifiers; Biosurfactants; Emulsion technology; Water-in-oil; Drugs

Introduction

Emulsions are heterogeneous systems in which droplets of one liquid with a diameter greater than 0.1 m are dispersed across another. The term "emulsion" refers to a combination of water and oil that has been homogenised through the use of an emulsifier. Organic skincare and haircare formulators have access to a wide range of emulsifiers on the market. They can be hot-processed or cold-processed oil-in-water (O/W) or water-in-oil (W/O) emulsifiers. Oil-in-water (O/W) emulsifiers are emulsifiers that spread out small droplets of oil across an aqueous base. O/W emulsions that are more liquid include milk and skin-cleansing lotion. In a water-in-oil (W/O) emulsion, the ultra-fine water droplets disperse throughout the fatty base components. These emulsions are naturally thick and greasy. O/W emulsions are popular among many of our Formula Botanica pupils, presumably because they resemble conventional lotions and creams. The hydrophilic-lipophilic balance of a surfactant represents the equilibrium between the hydrophilic (oil-loving) and lipophilic (water-loving) components of an amphiphilic molecule (a molecule that has both lipophilic and hydrophilic parts).

Anyone who tells you to figure out your emulsifiers' HLB is probably used to working with synthetic emulsifiers and isn't familiar with the difficulties of formulating organic cosmetics. Making sure that the emulsions stay stable is one of the most challenging responsibilities for emulsion formulators. The water and oil may gradually start to separate from one another again if your emulsion is unstable. Phase separation is what this is, and it means that your nice lotion has devolved into a whole mess. Amphiphilic substances that may adhere to the surfaces of oil droplets and lower interfacial tension while preventing aggregation are referred to as "emulsifiers." An ideal natural emulsifier must [1-63] instantly adhere to the oil droplet surfaces created during homogenization, drastically lower the oil-water interfacial tension, and produce a protective barrier in order to facilitate droplet fragmentation (to inhibit droplet coalescence within the homogenizer). Furthermore, in the conditions that a commercial product may encounter, the emulsifier coating should keep the lipid droplets in the emulsion stable. Emulsifiers are essential components in creating stable emulsions with sufficient shelf life and useful characteristics. SSE-20 and SSE, as well as emulsifiers derived from animals such caseinate, gelatin, whey protein, and egg protein. A lot of businesses are reformulating their goods to replace synthetic surfactants with more label-friendly natural alternatives or to replace animal proteins with plant proteins as a result of rising consumer demand for more natural, sustainable, and environmentally friendly commercial items. Nonionic, naturally occurring emulsifiers, PEG-20 Methyl Glucose Sesquistearate and Methyl Glucose Sesquiatearate work well together or independently.

Ecocert emulsifiers

ECOCERT was the first certification body to establish standards for "natural and organic cosmetics." ECOCERT, a French company created in 1991 that specialises in the certification of organic products, has made a name for itself as a leading authority on organic certification, notably among consumers and professionals. The conformity of a product, service, or system with environmental and social norms set out in a standard is evaluated by an impartial and objective certification body. In a cream or lotion, there are two phases: an oil phase and a water phase. An emulsifier is necessary to create a cream or lotion since water and oil do not naturally interact. Hydrophilic (loving water) and lipophilic (loving fat) components make up emulsifiers (oil loving). This suggests that they are drawn to both water and oil, enabling them to combine the two to form an emulsifier. Ecologically sound methods were used to manufacture natural emulsifiers without the use of solvents or petrochemicals. These emulsifiers are all-in-one and do not require additional emulsifiers or "co" emulsifiers.

Natural/naturally derived emulsifiers that are commercially accessible:

a) Acacia gum

b) Lysofix

c) Speramox

d) Bee wax

e) Lecithin

f) Methyl glucose Sesquistearate

g) PEG-20 methyl glucose Sesquistearate

Natural emulsifiers effect on the creation of emulsions

Effect of natural emulsifiers on the production of emulsions. Emulsifiers help generate small lipid droplets during homogenization and then they increase the stability of the lipid droplets once they have been formed, which is crucial for the creation of successful emulsion-based products. Understanding the factors that affect these two distinct functions is essential when assessing the potential performance of natural emulsifiers. A natural emulsifier must have a surface-active molecule or colloidal particle that can quickly bind to the surfaces of the oil droplets created during homogenization. After adsorption, the emulsifier must rapidly lower the interfacial tension to enable droplet breakup, the generation of small droplets, and the production of a coating that prevents the droplets from aggregating. The emulsifier may also need to be selected to guarantee that the lipids are completely digested and absorbed inside the GIT and to prevent encapsulated lipids from chemical oxidation (such as that which occurs to polyunsaturated lipids). Surface load (), which can vary greatly for natural emulsifiers, is the main factor that determines how much emulsifier is needed to produce an emulsion with droplets of a particular size.

Principal natural-based emulsifier groups

Groups of natural-based emulsifiers Natural emulsifiers come in a variety of chemical forms. Aspects such as the natural source utilised, or the extraction procedure might lead to differing qualities within each family. As a result, the following sections describe the most important families of natural emulsifiers and their context in the field of food applications.

a) Phospholipids

b) Saponins

c) Proteins

d) Polysaccharides

To create small droplets, surface-active polysaccharides are often used in high concentrations, but the resultant droplets are very resistant to environmental changes. On the other hand, surface-active proteins are often utilised in tiny amounts, but the droplets produced are incredibly sensitive to variations in pH, ionic strength, and temperature. Some phospholipids can create very small oil droplets during homogenization, but these droplets are very sensitive to changes in the surrounding environment. Saponins, a class of biosurfactants, can be employed sparingly to create stable thin oil droplets under a range of environmental situations. Big oil droplet emulsions can be stabilised by using some natural nanoparticles (such cellulose, chitosan, and starch). Future research should concentrate on finding, isolating, characterising, and testing new natural emulsifiers for usage in foods, cosmetics, detergents, personal care products, and other products.

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What are the best natural emulsifiers? Wax is probably used most often as a natural emulsifier, and it is a great choice when making a homemade skin care product. Beeswax, candelilla wax, carnauba wax, and rice bran wax can all be used as a wax emulsifier. When looking for a natural option, make sure that you are using a non-GMO wax that is vegetable-derived and made with natural ingredients.

a) Candelilla Wax

b) Carnauba Wax

c) Rice Bran Wax

Emulsifiers derived from natural sources, such as microbial sources

Emulsifiers made from natural sources, such as microorganisms: The manufacture of emulsifiers via microbial synthetic techniques is becoming a practical, sustainable, and ecologically benign solution. They produce chemicals with low ecotoxicity, biodegradability, stability (pH and salinity), and low critical micellar concentration in addition to biological activity, biocompatibility, and digestibility (CMC). Microorganism-produced emulsifiers are categorised based on their molecular weight. Glycolipids (such as rhamnolipids, sophorolipids, and trehalose lipids) and lipopeptides are a class of low molecular weight compounds known as biosurfactants (e.g., surfacing, iteron, fengycin). Polysaccharides, proteins, lipoproteins, and lipopolysaccharides are all members of the high molecular weight family and are considered bioemulsifiers. The majority of bacteria, such as Pseudomonas aeruginosa, Pseudomonas fluorescens, Rhodococcus erythropolis, Nocardia erythropolis, Arthrobacter sp., or Mycobacterium sp., produce glycolipids including rhamnolipids and trehalose lipids, whereas yeasts, such as Candida Bacillus sp., Serratia marc

Discussion

Technology based on emulsion

Emulsions are colloidal systems composed of two immiscible liquids (oil and water) that are combined in the presence of an emulsifier and, in most instances, an energy source. Choosing an emulsifier is therefore an important step in obtaining stability. They are divided into three categories based on whether or not they have charged centers (amphoteric surfactants), vary charge with pH, or have hydrophilic areas that match ionic structures (anionic or cationic surfactants) (nonionic surfactants). Because they are less toxic and less affected by changes in pH and ionic strength, nonionic surfactants in particular are commonly used in food applications. A nonionic surfactant can be chosen using the hydrophilic-lipophilic balance (HLB) index. A lower HLB value indicates that a lipophilic surfactant is best for stabilising water-in-oil (W/O) emulsions, whereas a higher HLB value indicates the ability to stabilise oil-in-water (O/W) emulsions due to the strong hydrophilic balance. This scale (0–20) reflects the transition from hydrophobic to hydrophilic character. Emulsions are created using the phase inversion method, membrane emulsification method, dry gum method, and wet gum method. The continental/dry gum method and the bottle/general approach are the two emulsification techniques that are most often utilised. The membrane emulsification method, which is based on the principle of dispersing one immiscible phase (dispersing phase) into another phase (continuous phase) by applying pressure, is used to create many emulsions.

Classification of emulsions

Emulsions are categorised depending on their typology and structural makeup. While the latter pertains to the relative distribution of the immiscible phases, the former concerns the organisation of the emulsified entities (oil and water). Depending on the typology, they can be categorised as simple (O/W and W/O) or double (oil-in-water-in-oil (O/W/O) and water-in-oil-in-water (W/O/W) emulsions). Examples of O/W emulsions in food systems include milk, sauces, beverages, yoghurts, ice creams, and mayonnaise. Although they are less frequent, W/O emulsions can be found in butter and margarine. The most often used double emulsions are W/O/W systems because they can result in lower-fat products than O/W emulsions. Additionally, they can serve as a base for encasing and regulating the release of delicate water-soluble compounds like flavours or bioactive ingredients. Based on their structure, emulsions can be classified as macroemulsions (sometimes called emulsions), nano emulsions, or microemulsions. These systems' distinctive physicochemical characteristics define their potential for use. Emulsions and nano emulsions are thermodynamically unstable systems because their free energy is higher than that of the individual phases.

Mechanisms of stabilisation

Emulsions are thermodynamically unstable combinations containing at least two immiscible phases and an emulsifier that, with enough mixing energy, may maintain stability over time. The emulsifier's role is critical in ensuring long-term stability of characteristics. Emulsifiers are active surface compounds that allow them to be positioned at the oil–water interface, lowering interfacial tension and preventing (or delaying) aggregation. This pattern is depending on the nature of the emulsifiers, ranging from minutes (e.g., certain saponins) to hours (e.g., some proteins), as well as ambient circumstances (e.g., pH, temperature). It's worth noting that, while monolayer structures around the droplets are typically used to stabilise emulsions, multilayer structures can also be created. The multilayer design encourages the droplets to repel each other electrostatically and sterically, boosting stability while also protecting the interior phase. Depending on the type of surfactant utilised, the emulsion stabilisation method might be different. Following are the four main stabilisation mechanisms recognized in this context.

a) Electrostatic repulsion

b) Steric repulsion

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c) The Marangoni-Gibbs effect

d) Thin film stabilisation processes

Electrostatic repulsion: It is linked to ionic emulsifiers and is characterised by the creation of an electrical double layer at the droplet interface, which prevents the droplets from approaching each other.

Steric repulsion: It is a property of non-ionic and/or polymeric emulsifiers, and the droplet spacing is maintained due to the oil phase's adsorption of the hydrophobic segment.

Marangoni Gibbs effect: It preserves emulsion structure by deforming nearby droplet surfaces, blocking their outflow.

Thin film stabilisation mechanism: It ensures emulsion stability by producing a stiff and viscoelastic film, which protects droplets from destabilising effects. Other parameters, such as the emulsifier concentration, the oil-to-water ratio, or the preparation circumstances, might influence the emulsion's stabilisation process (pH or temperature). Some phospholipids, for example, can have no charge at neutral pH but become anionic in acidic conditions, causing the molecule to enlarge at the interface. Furthermore, the surfactant concentration can have an influence; for example, sunflower lecithin in O/W emulsions creates a coating encircling the oil droplets at low concentrations, but at greater concentrations, the stabilisation process alters, forming liposomes that may destabilise the emulsion. When amphiphilic polymers are utilised as emulsifiers, they are positioned at the interface in the same way as tiny molecules are, but their capacity to generate intermolecular contacts can give extra stabilising benefits.

Ionic emulsifiers are associated with electrostatic repulsion, which is characterised by the formation of an electrical double layer at the droplet interface that stops the droplets from moving toward one another. Non-ionic and/or polymeric emulsifiers have the steric repulsion feature, and the oil phase's adsorption of the hydrophobic segment maintains the droplet spacing. By bending neighbouring droplet surfaces and preventing their outflow, the Marangoni Gibbs effect protects the emulsion's structure. By creating a rigid and viscoelastic coating that shields droplets from destabilising factors, the thin film stabilisation mechanism assures the stability of the emulsion. The stabilisation process of the emulsion may be impacted by several factors, such the emulsifier concentration, the oil-to-water ratio, or the conditions of preparation (pH or temperature). When exposed to acid, certain phospholipids, for instance, might lose their charge and become anionic, which causes the molecule to expand at the contact. Additionally, the amount of the surfactant can make a difference. For instance, sunflower lecithin in O/W emulsions forms a coating around the oil droplets at low concentrations, but at higher concentrations, the stabilisation process changes and liposomes form, which may cause the emulsion to become unstable. Amphiphilic polymers are positioned near the interface in the same manner as small molecules are when used as emulsifiers, but their ability to create intermolecular interactions can provide additional stabilising effects.

Emulsion consistency/stability

Emulsion stability is a crucial indicator of a product's ability to tolerate long-term physicochemical changes. Depending on the intended final usage, different emulsions require different levels of stability. Short-term stability of minutes to ours is sufficient for intermediate food emulsions such cake batter and ice cream mixtures, but long-term stability is required for prolonged shelf life. Mayonnaise and salad dressings are among the 14 ingredients listed under "Food Additives." Identifying the key mechanisms that contribute to this influence is necessary in the latter situation in order to create effective strategies to prevent emulsion instability. Physical and/or chemical processes may result in emulsion instability. Changes in the spatial distribution and structure of emulsion droplets, such as gravitational separation (creaming/sedimentation), flocculation, coalescence, and Ostwald ripening, are the result of physical instability. The composition and structure of the emulsion as well as the storage conditions, which include temperature variations and mechanical churning, have an impact on these effects. Furthermore, during emulsion preservation, the physical phenomena are interconnected and might have an impact on one another. Gravitational separation is brought about by the disparities in densities between the droplets and the continuous phase. The droplets are subject to gravitational forces, which lead them to assemble at the top (creaming) or bottom of the system (sedimentation). Most edible oils have densities below that of water, which makes them cream better in O/W emulsions but more likely to silt in W/O emulsions. Separation often occurs in emulsions with droplet sizes greater than 100 nm or as the last event in a chain of instability events because of the gravitational forces acting on large droplets. At lower droplet sizes, such as nano emulsions, however, Brownian motion predominates over gravitational forces. Therefore, delaying gravitational separation by reducing droplet size is a successful strategy, with the emulsifier being a crucial component in this operation. By minimising the density difference between the emulsion phases, the emulsifier layers also have a tendency to slow down the velocity of gravitational separation. Two other choices include increasing the concentration of the droplets or changing the rheology of the continuous phase. Ostwald ripening is the process of enlarging droplets by allowing smaller droplets to diffuse into larger ones as a result of their solubility in the continuous phase. This effect is influenced by the properties of the emulsifiers and is amplified as the droplet size decreases. Ostwald ripening can be delayed by reducing the interfacial tension between the phases. This is particularly useful when using small-molecule surfactants or emulsifiers that can create a tough shell around the droplets. Emulsifiers that are likely to solubilize the oil and water phases by creating colloidal structures speed up the Ostwald Ripening (e.g., micelles). The aggregation of droplets, which results in an increase in droplet size, is connected to the processes of coalescence and flocculation. In

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flocculation, at least two droplets in an aggregate join together, but in coalescence, the droplets combine to form a single, bigger droplet. Emulsifiers or co-emulsifiers can be employed in emulsions to stop lipid oxidation.

Emulsions come in a variety of forms

Single Emulsions are a type of emulsion that is made up of only one

Water with oil

Oil- in- water

Double or Multiple Emulsions

Water in oil in water

Oil in water in oil

Microemulsions

Emulsions of Pickering

Microemulsions: These are liquid solutions made up of water, oil, and a surfactant that form a single optically isotropic and thermodynamically stable solution. O/W (oil in water) and W/O (water in oil) micro emulsions are the two varieties available. In order to make an O/W microemulsion, a w/o emulsion was used in conjunction with a surfactant with a low hydrophilic lipophilic balance (HLB) value. An aqueous solution with a high HLB number surfactant is added to this emulsion, and after a given amount of stirring, a gel' phase is formed, and additional surfactant addition results in an inversion into an O/W emulsion. O/W emulsion stabilised with an ionic or non-ionic surfactant was suggested for W/O microemulsion. This emulsion is titrated with a co-surfactant, and the emulsion goes through a gel phase before being converted to a W/O microemulsion by adding more co-surfactant. The likelihood of disrupting the crystalline structure of the stratum corneum is a disadvantage of microemulsion. Irritation of the skin occurs as a result of several factors.

Emulsions can be used for a variety of purposes

Formulation for ingestion: Increasing the bioavailability of a drug.

Allowing for a regulated rate of medication release.

Protecting against oxidation or hydrolysis.

Formulation for the skin: Simple to use and may be designed to remove oiliness and stains.

Transporting water, which is a fantastic skin softener.

Identifying the different forms of emulsions: In terms of the water-to-oil phase ratio.

In ascending sequence of addition.

By emulsifier type.

Types of emulsions to choose from

- Oral fats or oils (for example, O/W is created to cover an unpleasant taste).
- For intravenous delivery (O/W or W/O).

For use with external programmers.

a) O/W emulsion:

Drugs that are water soluble.

Easy to remove off the skin.

The texture is non-greasy.

b) W/O emulsion:

Occlusive action

May affect medication absorption.

Skin cleansing.

Creams that moisturise the skin.

Emulsification uses

Emulsification is used to hide the flavour of something.

O/W is a handy way to provide water-insoluble liquids orally.

When compared to their oily solution formulations, the O/W emulsion enhances the absorption of water insoluble substances (e.g., vitamins).

Oil-soluble medications can be administered to children as an oil-in-water emulsion.

Emulsion is a cosmetic and therapeutic emulsion that may be applied externally.

Emulsions are used in the pharmaceutical industry for a variety of reasons: Both macro and micro emulsions were effective as drug carriers for hydrophilic and lipophilic substances. Liquid dispersion systems received a lot of interest once the size distribution and stability phenomena were controlled, opening up new research areas. The primary advantage of such systems is their potential to favour topical delivery of hydrophilic medicines while also improving the solubility and bioavailability of therapeutic drugs. For regulated and sustained drug release, multiple emulsions-especially W/O/W emulsions-are fantastic choices. These may also be used in place of liposomes as delivery vehicles. Microemulsions are thermodynamically stable and may form spontaneously; by combining a variety of medication molecules, they improve drug solubilization and bioavailability as well as functioning as potential drug delivery methods. The most popular intravenous emulsions are oil in water and W/O/W emulsions. Lipid emulsions are used for parenteral nutrition, intravenous drug administration, and oxygen carriers. Emulsions have been utilised for hundreds of years to treat localised skin issues. Skin lacerations are typically treated using oil-in-water emulsions. A first-pass metabolic activity and bypassing the gastrointestinal environment are two advantages of using topical emulsions. For oral formulations and methods, emulsions are also used. They are mostly used to create laxatives or enteric food. In addition to the functions listed above, the emulsions may also be used to personalise drug delivery to certain organs, boost pharmacological impact, and stabilise hydrolytically susceptible medicines for longer release by decreasing irritation or toxicity. Griffin created a system for categorising surfactants based on their water solubility, known as the hydrophilic lipophilic balance (HLB) scale, which is utilised for emulsions. The ratio of the surfactant's affinity for oil and water is represented by the system's numerical values, known as the hydrophilic-lipophilic balance (HLB). In order to create w/o emulsions, emulsifying agents with HLB values of 3 to 6 are used. Emulsifying agents having HLB values between 7 and 20 are used for o/w emulsions. Alfred claims that the relative solubility of the surfactants determines the kind of emulsion, with the continuous phase originating from the phase in which the surfactant is more soluble. This phenomenon is sometimes referred to as "The Bancroft Effect," also known as "The Bancroft Rule."

Emulsifying agents are divided into groups depending on their chemical structure and mode of action: Emulsifiers are classed as synthetic, natural, finely dispersed solids, and auxiliary agents based on their chemical structure. Monomolecular, multimolecular, and solid particle films are examples of classes depending on mode of action (s). emulsifiers, both ionic and amphoteric. The next sections go through each of these classes in detail.

Emulsifiers that are anionic: The hydrophilic moiety of anionic surfactants is a polar group that is negatively charged in aqueous solutions or dispersions. In commercial products, it's either a carboxylate, sulphonate, sulphate, or phosphate group. The solubilizing power of the carboxylate group is significantly lower than that of the other groups in neutral or acidic conditions or in the presence of heavy metal ions.

Carboxylates: Soaps and a tiny number of amino carboxylates are the only anionic surfactants commercially accessible in the carboxylate class of surfactants.

Soaps: Soaps, particularly amine salts, have a wide range of commercial applications as emulsifiers, dispersants, and solubilizing agents.

Soaps: Soaps also have an emollient effect when they come into touch with the skin and leave a soft feel on textiles.

Amino carboxylates: N acylsarcosinates and acylated protein hydrolytes are two forms of amino carboxylate surfactants generated.

N Acylsarcosinates: Sodium N Oleoylsarcosinate and sodium N acylsarcosinate are soap-like detergents with good lathering properties that are derived from coconut fatty acids. Oleoylsarcosinate is a detergent and auxiliary for textiles.

Acylation of fatty acid chlorides or direct condensation with fatty acids produce fatty acyl amino carboxylates from protein hydrolysates. Although derivatives of incompletely hydrolysed peptides have a high tolerance for hard water, they are less efficient as surfactants.

Sulfonates:

The sulfonate group of the general formula is the most effective structure for anionic surfactants. RSO3Na, where R is a biodegradable hydrocarbon group in the surfactant molecular weight range that can be alkyl or alkyl aryl, and product is a random combination of isomers as long as there is no chain branching that interferes with biodegradability.

Sulfates and sulfate-based products include: The hydrophilic group in these emulsifying agents is SO3, which is attached to a carbon atom in the hydrophobic moiety by an oxygen atom (s). The sulphate is a stronger solubilizing group than the sulfonate due to the additional oxygen, but the C-O-S linkage of the sulphates is hydrolysed more easily than the C-S linkage of the sulfonates

Natural fats and oils that are sulfated: Olive oil was the first non-soap oil to be sulfated in order to produce a commercial surfactant.

Cationic emulsifiers: Cationic surfactants are classed as quaternary ammonium compounds. Polyunsaturated fatty acid moieties are undesirable components of glycerides for sulfation because the resultant surfactants are generally dark in colour and vulnerable to oxidation. The head of a cationic surfactant is positively charged in solution, and they are commonly utilised as disinfectants and preservatives. They have strong antibacterial characteristics. They are used to clean wounds or burns on the skin. Cetrimide is a widely used cationic surfactant that contains tetra-decyltrimethyl ammonium bromide and a small quantity of dodecyl and hexadecyl compounds. Benzalkonium chloride, cetylpyridinium chloride, and other cationic surfactants are examples.

Non-ionic emulsifiers: These are surfactants that have no electrical charge(s), making them resistant to water hardness deactivation. These surfactants are less irritating than anionic or cationic surfactants. Saturated or unsaturated fatty acids, as well as fatty alcohols, make up the hydrophobic portion. They work well as emulsifiers and grease/oil removers. Non-ionic surfactants help to reduce the hardness sensitivity of the surfactant system. Poly oleasters, polyoxyethylene esters, poloxamers, and polyethylene glycol are examples of non-ionic surfactants (PEG 40, PEG -50, PEG- 55). The ethers of fatty alcohols are the most often utilised non-ionic surfactants.

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Monoglyceride (MG) glycerine fatty acid esters: Glycerine fatty acid ester is made up of glycerine and animal and plant oils/fats, as well as their fatty acids. The Inter-esterification method is commonly used to make these. Glycerine has three hydroxyl groups, one of which is esterified with a fatty acid, and the ester is known as mono glyceride. Two and three fatty acid groups are esterified at hydroxyl groups in di- and tri-glycerides, respectively.

Amphoteric/Zwitterionic emulsifiers: These are a kind of surfactant that is extremely gentle, making them ideal for use in personal care products for those with sensitive skin. Depending on the acidity or pH of the water, they can be anionic (negatively charged), cationic (positively charged), or non-ionic (no charge) in solution(s). These emulsifiers may have two charged groups of different signs, with the positive charge nearly invariably being ammonium and the negative charge coming from a variety of sources (carboxylate, sulphate, and sulphate(s)). The dermatological characteristics of these surfactants are outstanding. They're commonly utilised in shampoos, various cosmetic goods, and hand dishwashing solutions because of their great foaming characteristics.

Natural emulsifiers include Emulsifiers are natural materials generated from plant or animal tissue in a range of forms. And The majority of emulsifiers produce hydrated lyophilic colloids (also known as hydrocolloids) that form multimolecular layers around emulsion droplets. Hydrocolloid emulsifiers have little or no effect on interfacial tension, but they do have a protective colloidal effect, which reduces the chance of coalescence, so they're by–Quality of providing a protective sheath around the droplets.

The process of charging scattered droplets (so that they repel each other).

Swelling quality to improve the system's viscosity (making droplets less likely to combine).

Hydro colloidal emulsifiers may be classified as:

Vegetable derivatives such as Acacia, agar, pectin, carrageenan, and lecithin are other examples.

animal by-products, such as lanolin and cholesterol

Semi-synthetic agents, such as carboxy methyl cellulose and methylcellulose.

-Synthetic agents, such as those found in Carbopol.

Derivatives of vegetables

Natural plant hydrocolloids have the advantages of being inexpensive, simple to handle, and nontoxic. Their downsides include the fact that they must be used in large quantities to be efficient as emulsifiers, and they are typically susceptible to microbial development, which may be avoided by utilising a preservative system. The use of vegetable derivatives as emulsifiers in o/w emulsions is largely limited. Acacia: Acacia (also known as Gum Arabic) is a chemically complex combination of large molecules of various sizes, with carbohydrates and proteins making up the majority of its makeup. It is utilised as a stabiliser, thickener, and/or emulsifier agent in the food business (examples like, soft drink syrup, gummy candies and creams). Acacia is employed as an emulsifier in pharmaceutical preparations and as a drug carrier in the pharmaceutical industry since it is physiologically inert.

Carrageenan: It is a natural emulsifier that may be utilised in a variety of ways. Carrageenan is a kind of sulfated polysaccharide derived from red seaweeds. Carrageen comes in a variety of shapes and sizes.

Pectin: It is a natural chemical found in all fruits and vegetables, and it is a component of the intermediate lamella and main cell wall. It is hydrocolloid in nature and has a high propensity to swell. Pectin is a polygalacturonic acid composed mostly of D-galacturonic acid molecules connected together by (1,4)-glycosidic linkages.

Animal by-products: Lecithin's are natural compounds made by extracting and purifying phospholipids from naturally occurring products like sunflower seeds, soybeans, eggs, and canola seeds. These are amphiphilic (they have different affinities for oil and water) and have low production costs, making them extremely useful in a variety of manufacturing processes. These are mostly employed as emulsifiers. They are surface-active; their combined hydrophilic (water-loving) and hydrophobic (water-repelling) qualities allow lecithin to create stable mixtures of components that would otherwise be difficult to mix and separate.

Animal derivatives are more prone to produce allergic responses and are susceptible to microbial development and rancidity. The capacity to facilitate the production of w/o emulsions is one of its advantages.

Agents that are semi-synthetic

These are more powerful emulsifiers that are also nontoxic and less prone to microbial development. Methylcellulose and carboxy methyl cellulose are two examples.

Methylcellulose (MC)

It is a type of cellulose. It's one of the most common types of cellulose. This polymer is a white powder with little or no odor or flavour. Because methylcellulose has no ionic charge, the viscosity of its solutions is mostly unaffected by pH. Small concentrations of salts, on the other hand, might enhance the viscosity of solutions.

Natural Emulsifiers Have the Following Advantages over Synthetic Emulsifiers

a) They are readily available, inexpensive, and biocompatible.

b) Natural materials are frequently similar, if not identical, to macromolecular materials, which the biological environment can recognize and process via metabolic pathways. Natural materials can function biologically at the molecular level as well as at the macroscopic level.

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c) Natural materials suppress the inflammatory response elicited by synthetic materials.

d) Betaine, carbomer, carboxymethyl cellulose, cete aryl alcohol, coco betaine, ethyl acetate, glyceryldialeate, PEG family, Sorbian stearate, and other synthetic emulsifiers are used in topical applications; however, these emulsifiers can cause mild skin and eye irritation. They can generate very strong carcinogenic nitrosamines when they combine with nitrites. These Nitrosamines have been demonstrated to permeate the skin easily.

e) Detergents based on DEA, such as Cocamide DEA or MEA, Laramide DEA, and others, are the most often used compounds in cosmetics. It's found in a variety of detergents, liquid soaps, polishers, cutting oils, and lubricating fluid, as well as being used as a solvent in a variety of medications and home cleaning goods. It is a mild skin and eye irritant that can form highly potent carcinogenic nitrosamines when combined with nitrites. They have been shown to penetrate the skin with ease. In two studies conducted in 1991, NDELA (a nitrosamine) was discovered in 27 of the 29 goods examined. The use of DEA-based detergents on the skin repeatedly resulted in severe malignancies such as liver and kidney tumours. The NTP (Federal National Toxicology Program) said that DEA not only absorbs rapidly through the skin, but also accumulates in organs such as the brain, where it can cause toxicity. The relevance of natural emulsifiers has grown as a result of safety concerns about synthetic emulsifiers.

Emulsifiers from nature

a) May vary a lot from batch to batch.

b) Synthetic emulsifiers have a known structure and behavior; nonetheless, they may affect the emulsion's scent and colour.

c) Synthetic emulsifiers have no effect on the aroma or colour of the product, but they are more expensive and not usually readily accessible. Synthetic emulsifiers are so widespread that they are widely accessible and inexpensive. don't contribute texture or consistency to the emulsion; you must then add other components. Texture can be added to an emulsion using synthetic emulsifiers.

Conclusion

Based on the findings of the preceding studies, it can be concluded that emulsions are a broad category of dosage forms that aid in drug delivery. These emulsions can be used to achieve complete biodegradability, increase drug dosing intervals, and mask the taste of bitter drugs. It is vital to remember that we can entrap both hydrophilic and hydrophobic medicines in emulsions. It was also discovered that preparing the drugs as emulsions can protect them from endogenous factors. More research is needed to solve the problem of emulsions having a short shelf life. Because these emulsions are only packaged in plastic or glass containers, a marketing ruse must be devised if at all possible. To meet customer desire for clearer labelling, there is a lot of interest in creating food items using all-natural components. The food industry may employ a range of natural emulsifiers to stabilise emulsions, each having its own set of benefits and drawbacks in terms of emulsion creation and stability. With a greater knowledge of the molecular foundation of emulsifier performance, it will be easier to choose the best natural emulsifier for a given application. Emulsions are a large group of dosage forms that assist in drug administration, it may be inferred from the results of the earlier investigations. These emulsions can be used to completely biodegrade substances, lengthen medicine dosage intervals, and disguise the flavour of bitter substances. It's important to keep in mind that emulsions might contain both hydrophilic and hydrophobic medications. Additionally, it was shown that putting the medications into emulsions can shield them from endogenous elements. The issue of emulsions having a short shelf life requires more study. If at all feasible, a marketing ploy should be developed because these emulsions are only sold in plastic or glass containers. There is a lot of interest in developing food products utilising only natural ingredients to satisfy consumer demand for clearer labelling. To stabilise emulsions, the food industry may use a variety of natural emulsifiers, each of which has advantages and disadvantages in terms of emulsion production and stability. It will be simpler to select the optimum natural emulsifier for a specific application once the molecular basis of emulsifier function is well understood.

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