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Drug Dosage Forms-Expanding Horizon

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Abstract: *In this twenty first century various drug dosage forms have come in to picture. A diverse range of delivery systems has been developed to provide for the care and welfare of patients. Some researchers consider drug dosage forms as drug delivery systems which been followed from my end . The development of delivery systems draws on the discipline of biopharmaceutics, which integrates an understanding of formulations, dissolution, stability, and controlled release (pharmaceutics); absorption, distribution, metabolism, and excretion (Pharmacokinetics, PK); Concentration-Effect Relationships And Drug-Receptor Interactions (Pharmacodynamics, PD); And Treatment Of The Disease State (Therapeutics). Formulation Of A Delivery System Typically Involves Combining An Active Ingredient And One Or More Excipients; The Resultant Dosage Form Determines The Route Of Administration And The Clinical Efficacy And Safety Of The Drug this Article Summarizes Various New And Old Dosage Forms.Some Of The Old Dosage Forms Are Tablets, Injections,Inhalers,Powder,Paste,shampoo etc.Data was collected from Wikipedia,data standards manual etc.This review article first focuses old models of dosage forms and types of dosage forms according to route of administration.Later the paper emphasizes on new drug delivery system like transdermal delivery of drugs, ocular inserts,monoclonal antibodies,targeted drug delivery etc.*

Key Words: *Drug dosage forms,routes of administration,tablet,injection,transdermal drug delivery system and targeted drug delivery.*

I. Introduction

A dosage form is the way of identifying the drug in its physical form. In determining dosage form, FDA examines such factors as (1) physical appearance of the drug product, (2) physical form of the drug product prior to dispensing to the patient, (3) the way the product is administered, (4) frequency of dosing, and (5) how pharmacists and other health professionals might recognize and handle the product."

Dosage forms[1] (also called unit doses) are essentially pharmaceutical products in the form in which they are marketed for use, typically involving a mixture of active drug components and nondrug components (excipients), along with other non-reusable material that may not be considered either ingredient or packaging (such as a capsule shell, for example). The term unit dose can also sometimes encompass non-reusable packaging as well (especially when each drug product is individually packaged), although the FDA distinguishes that by unit-dose "packaging" or "dispensing.".Depending on the context, multi(ple) unit dose can refer to distinct drug products packaged together, or to a single drug product containing multiple drugs and/or doses. The term dosage form[2] can also sometimes refer only to the chemical formulation of a drug product's constituent drug substance(s) and any blends consumable product such as a capsule, patch, etc.). Because of the somewhat vague involved, without considering matters beyond that (like how it's ultimately configured as a boundaries and unclear overlap of these terms and certain variants and qualifiers thereof within the pharmaceutical industry, caution is often advisable when conversing with someone who may be unfamiliar with another person's use of the of the term.

The data was collected from Wikipedia,[3]drug standard manual,International journal of research in pharmacy and chemistry,Asian journal of pharmaceutics,journal of drug delivery and therapeutics ,drugs.com and pubmed.

Some Well Known and Popular Dosage Forms

According to FDA data, version number 008 some of the definitions are given below.

AEROSOL	A product that is packaged under pressure and contains therapeutically active ingredients that are released upon activation of an appropriate valve system; it is intended for topical application to the skin as well as local application into the nose (nasal aerosols), mouth (lingual aerosols), or lungs (inhalation aerosols

BAR, CHEWABLE	A solid dosage form usually in the form of a rectangle that is meant to be chewed.
CAPSULE	A solid oral dosage[4,5] form consisting of a shell and a filling. The shell is composed of a single sealed enclosure, or two halves that fit together and which are sometimes sealed with a band. Capsule shells may be made from gelatin, starch, or cellulose, or other suitable materials, may be soft or hard, and are filled with solid or liquid ingredients that can be poured or squeezed
CEMENT	A substance that serves to produce solid union between two surfaces
CIGARETTE	A narrow tube of cut tobacco (or other similar material) enclosed in paper and designed for smoking
CRYSTAL	A naturally produced angular solid of definite form in which the ultimate units from which it is built up are systematically arranged; they are usually evenly spaced on a regular space lattice.
CULTURE	The propagation of microorganisms or of living tissue sells in special media conducive to their growth.
DIAPHRAGM	A device usually dome-shaped, worn during copulation over the cervical mouth for prevention of conception or infection.
DOUCHE	A liquid preparation, intended for the irrigative cleansing of the vagina, that is prepared from powders, liquid solutions, or liquid concentrates and contains one or more chemical substances dissolved in a suitable solvent or mutually miscible solvents
ELIXIR	A clear, pleasantly flavored, sweetened hydroalcoholic liquid containing dissolved medicinal agents; it is intended for oral use
EMULSION	A dosage form consisting of a two-phase system[6] comprised of at least two immiscible liquids1, one of which is dispersed as droplets (internal or dispersed phase) within the other liquid (external or continuous phase), generally stabilized with one or more emulsifying agents. (Note: Emulsion is used as a dosage form term unless a more specific term is applicable, e.g. cream, lotion, ointment.)
ENEMA	A rectal preparation for therapeutic, diagnostic, or nutritive purposes
EXTRACT	A concentrated preparation of vegetable or animal drugs obtained by removal of the active constituents of the respective drugs with a suitable menstrua, evaporation of all or nearly all of the solvent, and adjustment of the residual masses or powders to the prescribed standards
FILM	A thin layer or coating.
GAS	Any elastic aeriform fluid in which the molecules are separated from one another and so have free paths
GEL	A semisolid3 dosage form that contains a gelling agent to provide stiffness to a solution or a colloidal dispersion.4 A gel may contain suspended particles.
GLOBULE	Also called pellets or pilules, are made of pure sucrose, lactose, or other polysaccharides. They are formed into small globular masses of various sizes, and are medicated by placing them in a vial and adding the liquid drug attenuation in the proportion not less than one percent (v/w). After shaking, the medicated globules are dried at temperatures not to exceed 40 degrees Centigrade.
GRANULE	A small particle or grain[7]
GUM	A mucilaginous excretion from various plants.
IMPLANT	A material containing drug intended to be inserted securely of deeply in a living site for growth, slow release, or formation of an organic union
INHALANT	A special class of inhalations consisting of a drug or combination of drugs, that by virtue of their high vapor pressure can be carried by an air current into the nasal passage where they exert their effect; the container from which the inhalant generally is administered is known as an inhaler
INJECTABLE, LIPOSOMAL	An injection, which either consists of or forms liposomes (a lipid bilayer vesicle usually composed of phospholipids which is used to encapsulate an active drug substance
INJECTION	A sterile preparation intended for parenteral use; five distinct classes of injections exist as defined by the USP.
INSERT	A specially formulated and shaped non-encapsulated solid preparation intended to be placed into a non-rectal orifice of the body, where drug is released, generally for localized effects
INTRAUTERINE DEVICE	A device inserted and left in the uterus to prevent effective conception

JELLY	A class of gels, which are semisolid systems that consist of suspensions made up of either small inorganic particles or large organic molecules interpenetrated by a liquid--in which the structural coherent matrix contains a high portion of liquid, usually water
LIQUID	A dosage form consisting of a pure chemical in its liquid1 state. This dosage form term should not be applied to solutions[8]
LOTION	An emulsion, liquid1 dosage form. This dosage form is generally for external application to the skin
LOZENGE	A solid preparation containing one or more medicaments, usually in a flavored, sweetened base which is intended to dissolve or disintegrate slowly in the mouth. A lollipop is a lozenge on a stick[9]
OIL	An unctuous, combustible substance which is liquid, or easily liquefiable, on warming, and is soluble in ether but insoluble in water. Such substances, depending on their origin, are classified as animal, mineral, or vegetable oils
OINTMENT	A semisolid3 dosage form, usually containing <20% water and volatiles5 and >50% hydrocarbons, waxes, or polyols as the vehicle. This dosage form is generally for external application to the skin or mucous membranes
PASTE	A semisolid3 dosage form, containing a large proportion (20 – 50%) of solids finely dispersed in a fatty vehicle. This dosage form is generally for external application to the skin or mucous membranes
PASTILLE	An aromatic preparation, often with a pleasing flavor, usually intended to dissolve in the mouth
PATCH	A drug delivery system that often contains an adhesive backing that is usually applied to an external site on the body. Its ingredients either passively diffuse from, or are actively transported from, some portion of the patch. Depending upon the patch, the ingredients are either delivered to the outer surface of the body or into the body. A patch is sometimes synonymous with the terms 'extended release film' and 'system'
PELLET	A small sterile solid mass consisting of a highly purified drug (with or without excipients) made by the formation of granules, or by compression and molding
PILL	A small, round solid dosage form containing a medicinal agent intended for oral administration.
PLASTER	Substance intended for external application made of such materials and of such consistency as to adhere to the skin and attach to a dressing; plasters are intended to afford protection and support and/or to furnish an occlusion and macerating action and to bring medication into close contact with the skin
POULTICE	A soft, moist mass of meal, herbs, seed, etc., usually applied hot in cloth that consists of gruel-like consistency
POWDER	An intimate mixture of dry, finely divided drugs and/or chemicals that may be intended for internal or external use
RING	A small circular object with a vacant circular center that is usually intended to be placed in the body by special inserters, where the medication is released, generally for localized effects
SALVE	A thick ointment or cerate (a fat or wax based preparation with a consistency between an ointment and a plaster
SHAMPOO	A liquid soap or detergent used to clean the hair and scalp and is often used as a vehicle for dermatologic agents
SOAP	Any compound of one or more fatty acids, or their equivalents, with an alkali; soap is detergent and is much employed in liniments, enemas, and in making pills. It is also a mild aperient, antacid and antiseptic
SOLUTION	A clear, homogeneous liquid1 dosage form that contains one or more chemical substances dissolved in a solvent or mixture of mutually miscible solvents
SPONGE	A porous, interlacing, absorbent material that contains a drug. It is typically used for applying or introducing medication, or for cleansing. A sponge usually retains its shape
SPRAY	A liquid minutely divided as by a jet of air or steam
STICK	A dosage form prepared in a relatively long and slender often cylindrical form
STRIP	A long narrow piece of material.
SUPPOSITORY	A solid body of various weights and shapes, adapted for introduction into the rectal orifice of the human body; they usually melt, soften, or dissolve at body temperature

SUSPENSION	A liquid1 dosage form that contains solid particles dispersed in a liquid vehicle[10]
SUTURE	A strand or fiber used to hold wound edges in apposition during healing[11,12]
SWAB	A small piece of relatively flat absorbent material that contains a drug. A swab may also be attached to one end of a small stick. A swab is typically used for applying medication or for cleansing
SYRUP	An oral solution containing high concentrations of sucrose or other sugars; the term has also been used to include any other liquid dosage form prepared in a sweet and viscid vehicle, including oral suspensions[13]
TABLET	A solid dosage form containing medicinal substances with or without suitable diluents[14,15]
TAMPON	A plug made of cotton, sponge, or oakum variously used in surgery to plug the nose, vagina, etc., for the control of hemorrhage or the absorption of secretions
TAPE	A narrow woven fabric, or a narrow extruded synthetic (such as plastic), usually with an adhesive on one or both sides.
TINCTURE	An alcoholic or hydroalcoholic solution prepared from vegetable materials or from chemical substances
TROCHE	A discoid-shaped solid containing the medicinal agent in a suitably flavored base; troches are placed in the mouth where they slowly dissolve, liberating the active ingredients.
UNASSIGNED	A dosage form has yet to be assigned
WAFER	A thin slice of material containing a medicinal agent

The above are gross definitions of different dosage forms.There are various subtypes in these definitions.These include aerosol[16] foam,metered,powder and spray[17].The types of capsule[18] are coated,pellets,extended release,delayed release,film coated extended release,gelatin coated and liquid filled[19].The types of granule are delayed release,effervescent,for solution,for suspension and extended release.The types of injections[20] are emulsion,lipid complex for solution,powder for suspension,extended release,powder lyophilized for liposomal suspension,lyophilized for solution,solution concentrate and suspension sonicated[21,22].The types of powder are dentrifice,for solution,for suspension and metered.The types of solutions[23] are concentrate,for slush,gel forming,extended release and drops.And lastly types of tablet include chewable,coated,delayed release,dispersible,effervescent,extended release,for solution,for suspension,multilayer,orally disintegrating,soluble and sugar coated.

New Drug Dosage Forms(New Drug Delivery Systems)[34]

1)Transdermal drug delivery
2)Ocular inserts
3)Etonogestral implant
4) Monoclonal antibody therapy
5) Targeted drug delivery

1)Transdermal Drug Delivery[35]

Transdermal drug delivery has made an important contribution to medical practice, but has yet to fully achieve its potential as an alternative to oral delivery and hypodermic injections. First-generation transdermal delivery systems have continued their steady increase in clinical use for delivery of small, lipophilic, low-dose drugs. Second-generation delivery systems using chemical enhancers, non-cavitational ultrasound and iontophoresis have also resulted in clinical products; the ability of iontophoresis to control delivery rates in real time provides added functionality. Third-generation delivery systems target their effects to skin's barrier layer of stratum corneum using microneedles, thermal ablation, microdermabrasion, electroporation and cavitational ultrasound. Microneedles and thermal ablation are currently progressing through clinical trials for delivery of macromolecules and vaccines, such as insulin, parathyroid hormone and influenza vaccine. Using these novel second- and third-generation enhancement strategies, transdermal delivery is poised to significantly increase impact on medicine[36]. Transdermal delivery represents an attractive alternative to oral delivery of drugs and is poised to provide an alternative to hypodermic injection too. For thousands of years, people have placed substances on the skin for therapeutic effects and, in the modern era, a variety of topical formulations have been developed to treat local indications. The first transdermal system for systemic delivery—a three-day patch that delivers scopolamine to treat motion sickness—was approved for use in the United States in 1979. A decade later, nicotine patches became the first transdermal blockbuster, raising the profile of transdermal delivery in

medicine and for the public in general[37]. Some transdermal drug delivery system(patches) available in the market are given below

DRUG	INDICATION
ESTRADIOL	POSTMENOPAUSAL SYNDROME
TESTOSTERONE	HYPOGONADISM IN MALES
CLONIDINE	HYPERTENSION
NITROGLYCERINE	ANGINAPECTORIS
FENTANYL	PAIN
NICOTINE	SMOKING CESSATION

First Generation Transdermal Delivery System

There are basically three generations of trans delivery systemThe first generation of transdermal delivery systems is responsible for most of the transdermal patches that have thus far been in clinical useThe first-generation approach to transdermal delivery is limited primarily by the barrier posed by skin's outermost layer called stratum corneum, which is 10 to 20 µm thick. Drug transport across the stratum corneum typically involves diffusion through the intercellular lipids via a path that winds tortuously around corneocytes, where hydrophilic molecules travel through the lipid head group regions and lipophilic molecules travel through the lipid tails[38].

Second Generation Transdermal Delivery System

The second generation of transdermal delivery systems recognizes that skin permeability enhancement is needed to expand the scope of transdermal drugs. Recognizing the need to increase skin permeability, second-generation delivery strategies have turned largely to the development of chemical enhancers Hundreds of different chemical enhancers have been studied, including off-the-shelf compounds and others specifically designed and synthesized for this purpose, such as Azone (1-dodecylazacycloheptan-2-one) and SEPA (2-n-nonyl-1,3dioxolane). Iontophoresis has been studied for moto increase transdermal delivery for more than a century by typically applying a continuous low-voltage current Ultrasound was first widely recognized as a skin permeation enhancer when physical therapists discovered that massaging anti-inflammatory agents into the skin using ultrasonic heating probes increased efficacy.[39]

Third generation transdermal delivery system

The third generation of transdermal delivery systems is poised to make significant impact on drug delivery because it targets its effects to the stratum corneum. This targeting enables stronger disruption of the stratum corneum barrier, and thereby more effective transdermal delivery, while still protecting deeper tissues. In this way, novel chemical enhancers, electroporation, cavitational ultrasound and more recently microneedles, thermal ablation and microdermabrasion have been shown to deliver macromolecules, including therapeutic proteins and vaccines, across the skin in human clinical trials. These advances were made possible in part by the emergence of technologies to localize effects to the stratum corneum combined with recognition that the safety afforded by localization should make these more aggressive approaches medically acceptable.[40]

2) Ocular Inserts

Ocular inserts are defined as preparations with a solid or semisolid consistency, whose size and shape are especially designed for ophthalmic application (i.e., rods or shields)[41]. These inserts are placed in the lower fornix and, less frequently, in the upper fornix or on the cornea. They are usually composed of a polymeric vehicle containing the drug and are mainly used for topical therapy. The inserts have been classified, on the basis of their physico-chemical behavior, as soluble (S) or insoluble (I). Only the latter types can usually deliver drugs by a variety of methods at a controlled, predetermined rate, but need removal from the eye when 'empty'. Soluble (S) inserts, also generally defined by some authors as erodible (E), are monolytic polymeric devices that undergo gradual dissolution while releasing the drug, and do not need removal[42]. The terms 'soluble' and 'erodible' are not interchangeable, and correspond to distinct chemical processes, even if a clear-cut distinction between the two mechanisms is sometimes difficult. True dissolution occurs mainly through polymer swelling, while erosion corresponds to a chemical or enzymatic hydrolytic process, inducing an osmotic pressure that stretches the elastic membrane and contracts the compartment including the drug, so that the active component is forced through the single drug release aperture B.Matrixsystems thatforms a three dimensional Ocular inserts are classified as given below: I. Insoluble ocular inserts; II. Soluble ocular inserts; III. Bio-erodible ocular inserts.I. Insoluble ocular inserts Inserts made up of insoluble polymer can be classified into two categories: A.Reservoir systems; B. Matrix systems.A. Reservoir systems each class of inserts shows different drug release profiles. The reservoir systems can release drug either by diffusion or by an osmotic process. It contains, respectively, a liquid, a gel, a colloid, a semisolid, a solid matrix, or a carrier containing drug. Carriers are madeof hydrophobic, hydrophilic, organic, natural or synthetic polymers.[43] They have been sub-classified into:

1. Diffusional inserts, e.g., 'Ocuserts'; 2. Osmotic insertsOcusert system is a novel ocular drug delivery system based on porous membrane. The release of drug from diffusional inserts/Ocusert is based on a diffusional release mechanism. It consists of a central reservoir of drug enclosed in specially designed microporous membrane allowing the drug to diffuse from the reservoir at a precisely determined rate. Briefly, it consists of a reservoir containing pilocarpine alginate enclosed above and below by thin EVA (ethylene-vinyl acetate) membranes. The insert is encircled by a retaining ring of the same material, impregnated with titanium dioxide.
2)Osmotic insert The osmotic inserts are generally composed of a central part surrounded by a peripheral part and are of two types:Type 1: The central part is composed of a single reservoir of a drug with or without an additional osmotic solute dispersed throughout a polymeric matrix, so that the drug is surrounded by the polymer as discrete small deposits. The second peripheral part of these inserts comprises a covering film made of an insoluble semi-permeable polymer. The osmotic pressure against the polymer matrix causes its rupture in the form of apertures. Drug is then released through these apertures from the deposits near the surface of the device.[44] Type 2: The central part is composed of two distinct compartments. The drug and the osmotic solutes are placed in two separate compartments, the drug reservoir being surrounded by an elastic impermeable membrane and the osmotic solute reservoir by a semi-permeable membrane. The second peripheral part is similar to that of type 1. The tear diffuse into the osmotic compartment network or matrix capable of retaining water, aqueous The second category, matrix system, is a particular group of insoluble ophthalmic devices mainly represented by contact lenses. It comprises of covalently cross-linked hydrophilic or hydrophobic drug solution or solid components. The hydrophilic or hydrophobic polymer swells by absorbing water. The swelling caused by the osmotic pressure of the polymer segments is opposed by the elastic retroactive forces arising along the chains or crosslinks are polymer stretched until a final swelling (equilibrium) is reached
II. Soluble ocular inserts These soluble inserts offer the advantage of being entirely soluble so that they do not need to be removed from their site of application, thus limiting the intervention to insertion only. They can be broadly divided into two types, the first one being based on natural polymers and the other on synthetic or semi-synthetic polymers. III. Bio-erodible ocular insertsThese inserts are formed by bio-erodible polymers (e.g., cross-linked gelatin derivatives, polyester derivatives) which undergo hydrolysis of chemical bonds and hence dissolution. The great advantage of these bio-erodible polymers is the possibility of modulating their erosion rate by modifying their final structure during synthesis and by addition of anionic or cationic surfactant[45].

3) Etonogestrel (Intradermal Route)

Etonogestrel implant is a medicine that is used in women to prevent pregnancy. It is a form of birth control. Etonogestrel contains a hormone in a flexible plastic rod about the size of a matchstick. It is effective for three years when inserted just beneath the skin of your upper arm.

4) Monoclonal Antibody Therapy

Monoclonal antibody therapy is a form of immunotherapy that uses monoclonal antibodies **(mAb) to specifically bind to target cells or proteins. This may then stimulate the patient's** immune system to attack those cells[46]. It is possible to create a mAb specific to almost any extracellular/ cell surface target, and thus there is a large amount of research and development currently being undertaken to create monoclonals for numerous serious diseases (such as rheumatoid arthritis, multiple sclerosis, Alzheimer's disease, Ebola and different types of cancers). There are a number of ways that mAbs can be used for therapy. For example: mAb therapy can be used to destroy malignant tumor cells and prevent tumor growth by blocking specific cell receptors [47]. Variations also exist within this treatment, e.g. radioimmunotherapy, where a radioactive dose localizes on target cell line, delivering lethal chemical doses to the target.

Targeted Conditions

Cancer

Anti-cancer monoclonal antibodies can be targeted against malignant cells by several mechanisms:Omalizumab inhibits human immunoglobulin E (IgE) and is useful in moderate-to-severe allergic asthmRadioimmunotherapy (RIT) involves the use of radioactively conjugated murine antibodies against cellular antigens. Most research currently involved their application to lymphomas, as these are highly radio-sensitive malignancies. To limit radiation exposure, murine antibodies were especially chosen, as their high immunogenicity promotes rapid clearance from the body. Tositumomab is an example used for non-Hodgkins lymphoma[48].

Antibody-directed enzyme prodrug therapy (ADEPT) involves the application of cancer associated monoclonal antibodies which are linked to a drug-activating enzyme[49]. Subsequent systemic administration of a non-toxic agent results in its conversion to a toxic drug, and resulting in a cytotoxic effect which can be

targeted at malignant cells. The clinical success of ADEPT treatments has been limited to date[50].However it holds great promise, and recent reports suggest that it will have a role in future oncological treatment[51].
Autoimmune diseases

Monoclonal antibodies used for autoimmune diseases include infliximab and adalimumab, which are effective in rheumatoid arthritis, Crohn's disease and ulcerative Colitis by their ability to bind to and inhibit TNF-α.Basiliximab and daclizumab inhibit IL-2 on activated T cells and thereby help preventing acute rejection.[52,53]

5) Targeted Drug Delivery

Targeted drug delivery, sometimes called smart drug delivery,is a method of delivering medication to a patient in a manner that increases the concentration of the medication in some parts of the body relative to others[54]. The goal of a targeted drug delivery system is to prolong, localize, target and have a protected drug interaction with the diseased tissue. The conventional drug delivery system is the absorption of the drug across a biological membrane, whereas the targeted release system releases the drug in a dosage form. The advantages to the targeted release system is the reduction in the frequency of the dosages taken by the patient, having a more uniform effect of the drug, reduction of drug side-effects, and reduced fluctuation in circulating drug levels[55]. The disadvantage of the system is high cost, which makes productivity more difficult and the reduced ability to adjust the dosages.

There are different types of drug delivery vehicles, such as polymeric micelles, liposomes, lipoprotein-based drug carriers, nano-particle drug carriers, dendrimers, etc. An ideal drug delivery vehicle must be non-toxic, biocompatible, non-immunogenic, biodegradable,and must avoid recognition by the host's defense mechanisms[56].

The most common vehicle currently used for targeted drug delivery is the liposome.Liposomes are non-toxic, non-hemolytic, and non-immunogenic even upon repeated injections; they are biocompatible and biodegradable and can be designed to avoid clearance mechanisms (reticuloendothelial system (RES), renal clearance, chemical or enzymatic inactivation, etc.)Lipid-based, ligand-coated nanocarriers can store their payload in the hydrophobic shell or the hydrophilic interior depending on the nature of the drug/contrast agent being carried.[57]

The only problem to using liposomes in vivo is their immediate uptake and clearance by the RES system and their relatively low stability in vitro. To combat this, polyethylene glycol (PEG) can be added to the surface of the liposomes. Increasing the mole percent of PEG on the surface of the liposomes by 4-10% significantly increased circulation time in vivo from 200 to 1000 minutes.

Another type of drug delivery vehicle used is polymeric micelles. They are prepared from certain amphiphilic co-polymers consisting of both hydrophilic and hydrophobic monomer units.They can be used to carry drugs that have poor solubility. This method offers little in the terms of size control or function malleability. Techniques that utilize reactive polymers along with a hydrophobic additive to produce a larger micelle that create a range of sizes have been developed.[58]

Dendrimers are also polymer-based delivery vehicles. They have a core that branches out in regular intervals to form a small, spherical, and very dense nanocarrier

The success of DNA nanotechnology in constructing artificially designed nanostructures out of nucleic acids such as DNA, combined with the demonstration of systems for DNA computing, has led to speculation that artificial nucleic acid nanodevices can be used to target drug delivery based upon directly sensing its environment. These methods make use of DNA solely as a structural material and a chemical, and do not make use of its biological role as the carrier of genetic information. Nucleic acid logic circuits that could potentially be used as the core of a system that releases a drug only in response to a stimulus such as a specific mRNA have been demonstrated. In addition, a DNA "box" with a controllable lid has been synthesized using the DNA origami method[59]. This structure could encapsulate a drug in its closed state, and open to release it only in response to a desired stimulus.

Nanotechnology In Dosage Forms And Delivery Systems

Nanotechnology is a new enabling technology with the potential to revolutionize animal health. A nanomaterial is usually defined as a material engineered to be less than 100 nm in one more dimensions. A nanometer is one one-billionth of a meter, and a human hair is approximately 80,000 nm across. Chemicals at the nanoscale display physical and chemical behaviors that can differ markedly from those of the bulk chemical (eg, in optical properties, conductivity, or electromagnetism). From a public and environmental health and safety perspective, the perceived benefits of nano-technology must be balanced with any potential risks.[60]

The main classes of nanomaterials are buckyballs (also known as fullerenes), nanotubes, quantum dots, dendrimers, nanoshells, and nanofibers. Potential applications of nanotechnology in animal health include disease diagnosis and treatment, “smart” drug delivery, and subcutaneous nanotube implants to measure

reproductive hormones. Targeted drug delivery in the future might involve surface-coated biocompatible nanoparticles such as dendrimers formulated to contain drugs or genes for intracellular delivery. In addition, "smart" treatment delivery systems on the nano-scale would allow judicious use of smaller quantities of drugs than would otherwise be possible. In the case of antibiotics, for instance, such systems would use less drug, thereby relieving concerns surrounding the potential development of antibiotic-resistant strains of bacteria in humans and increasing food safety for the consumer.

II. Conclusion

To conclude we have wide variety of drug dosage forms.Old dosage forms include aerosol,capsule,cream,diaphragm,douche,emulsion,enema,film,granule,injections,IUD,lotion,ointment,patch,powder,shampoo,solution,syrup and tablet.Classification of dosage form according to route of administrationwas briefed.New drug dosage forms like transdermal delivery system,ocular inserts,etonogestral implant,monoclonal antibodies ans targeted delivery system were discussed.To end with still there is a need for archetypal,flawless drug dosage form which has no disadvantages.

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