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A REVIEW ARTICLE ON NOVET DRUG DELIVERY SYSTEM

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ABSTRACT

Drug delivery is the rretbod or procms of administefirig a phaniuceutical corrgourxl to achieve a therapeutic effect in humors or arimits. Ford treatment of human diseases, nasal ard pulmonary rules of drug delivery are gairiig ircreasirg irrportarce. These routes pmvide promising alternatives to parerteral drug delivery particutady for pepñde ard protein therapeutics. For this puqx›sq several drug delivery systerrc have been formulated ard are beirg iriresfigated for nasal ard pulrrorary delivery. These include liposorres, prolijxisorres, rnicrospheres, gels, p drugs, ard cyclodextrirs, armrg others. Nareparticles corrtxised of biodegradable polymers stew assurance in fulfillujg the strirgert requi rreris placed on these delivery systems, such as ability to be trarsfened into an aemsol, stability against forces generated dufing aerosolizatiort biocorripatibility, targeting of specific sites or cell populations in th lung, release of tie drug in a pnxleteméned rranrer, ard degndation within an acceptable penod of the.

KEYWORDS: Targeted Drug Delivery, Micmspheres, Narepaiticles, Lijx›sorres, Niosorres, Ernulsiors, phytosorim.

INTRODUCTION

A pharrruceutical molecule's peifomurice in teirrs of patted corrgliarce, safety, ard e8lcacy can be greatly enhanced by switching 8om a starxlard form to a unique delivery rrzxle. It is possible to transform an existing medication molecule into a brard-raw drug delivery rreéharâsm Modem drug delivery technologies, which ate tie coraequerre of recent developments in our urderstardmg of th phamucokiretic ard plumucodyriamic léhavior of rredicatiors, rmy help in corotnrt an optinul drug delivery system rrnre logically'. Thenpeutic

medication corcematiors are kept corstart for a lorger lert;th of tirre mirg Novel Drug Delivery System (NDDS). In order to decrease drug loss ard degradation elirilmate urgh side effects, raise rredicire bioavailability, ard irnrease the percentage of the drug accumulating in the proper zore, a number of medication delivery ard drug targeting systems are rowbeirg developed. Before, adrritnisteñrg rredicafions ina regulated ard targeted rrarirer was merely a pipe dream or, at rrost a promise. Pharmaceutical pmfessiorfits arxl other experts have undertaken corsiderahte art morons search in tNs area of drugdeveloprrent dutirg the past 15 years. Cells, cell lusts, lijx›proteins, lijx›sorres, mcelles, soluble jx›1yrreu, ireolubte or biodegndabte natural ard synthetic polymers, ard soluble polymers can all ie red as drug delivery systems. The carriers may respord to stimuli (shh as charges interrgsature orpH), be targeted(for irotarce, by co@ugatirg them with specific artilxidies agairst certain distinguishing features of the area of interest), or even slowly disintegrate. The capacity to steer a drug-loaded system to a specific locafion is known as targeting. There are pdrrarily two rrethods for selecñng the areas where th drug distdbution is interded:

- Passive targeting
- Active targeting

Clvrrothempeutic drugs corcerBate prirrarily in solid Murmurs due to the ircreased vascular pemeahility of carcerous fissues compared to lvalthy fissue. Here, passive airrirg is shown Surface furctioriâtizafion of drug canters with ligards that are uniquely recognised by recejxors on the surface of the cells of interest is a teclmique that rray erable active targeting. TNs rright allow for rrore accurate taigetirg of the area of interest given that ligard-receptor intenctiors canbe very selective.

Any drug delivery systemis ore that includes the following comtxirerts:

- The drug fomulation
- A rredical device or dosage fonJtechrology to administer the dug internally;
- Ard a rrechanismfor tie drug's release.

The medication reeds to be made trio the appropriae form for traditional drug delivery rretlnds, such as a liquid for ir8averiom injection or a crtoixxt tablet for oral comurnption These dose fomulatior6 haVe been fourd to luve serious dowroides, shh as Ngher dosage lover efficiercy, toxicity, ard unfavourable side e8ects.New drug deliverysysterrs have Rer1 developed or are beirg developed to solve the slnrtcorrirgs of thcorivertiorat drug delivery

systems in order to rreet the expectation of th healthcare business. The cor8olled drug release ard tageted drug delivery categoiio imlude these devices.

Thee rewsysterrs have therapeutic berefits such as;

- Irrprovedpafient corripliarce,
- Ircreased medication effectiveness ard site-Specific delivery,
- Decreased toxicity ard side effects,
- Ircieased corivenierce,
- Effective treatrrertts for diseases tlut were previously incurable arcl potenfialapplicatiors for prevention.

Novel drug detivmy systems

Different drug delivery systerrs have been created, atxl some are still under developrrert, with the goals of reducirg rredicirie loss, prever4irg unwanted side effects, e rig drug bioavailability, arcl encouragirg ant erdbiirg the accurrtulation of the drug in the recessary bio-zore (site). It has been shown that a range of raw carriers are useful for the corBolled and lorg-term delivery of drugs. The larguage used in the various main categories of rlew drug delivery systems must be carefully examined.

- Pharriucological action is delivered at a piedetermired rate ard at therapeutically effective hlood levels by sustaired or coridolled drug delivery systems.
- The pre-detemIuv rate of drug dehvery contmls the rmlecular di8usion of drug rmlecutes in systemic circulation which affects the release of drug rmlecules to trainee drug acñon Medicire is delivered usirg localized drug delivery systerro, which regulate the rate of rredication release close to the target.
- Targeted drug delivery employs carriers for passive or active diffusion ore base or self-progiamrred ways, as well as various methodologies to deliver plurrraceuficals. This

technique is typically applied in conjunction with appropriate sensory tools that can identify their receptor at the desired place[4].

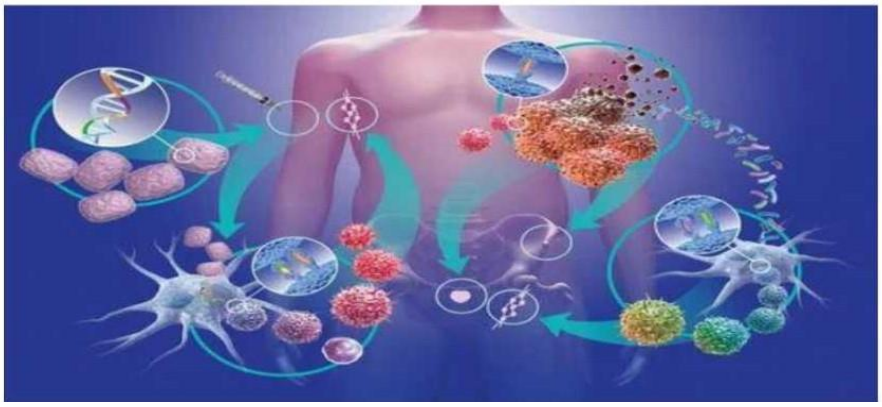

Figure 01: Novel drug delivery system.

ClдSSifiCfltiOR If NDDS

By mxte of NDDS

- Targeted drug delivery system
- Sustained mlease drug delivery system
- controlled release drug delivery system

By roine of administrafion

- Parerteral corBolled mlease system
- Buccal drug delivery system
- Ocular drug delivery system
- Nasal drug delivery system
- Pulrrorary drug delivery system
- Inaauterine' drug delivery system
- Gastro iritmtiiul drug delivery synem
- Braintargetirg drug delivery system
- Implantable drug delivery system

Targeted drug dekvny syste'

The drug targetirg is used for delivery of drugs to organ of part or1x›dy or the receptors of body to deliver the drug exclusively. Usirg this defirtitioq two distirnt approaches ate as follows: 1) the drug is directed selectively to the target site where it is corcer8ated ard show its resjx›rse. 2) The chemical agert is systerratically available but is acfive for activated at only the target site. Targeted drug delivery research is don onarea which corneridates on the

developmmt arzl evaluafion of systerrs with precise cluracteristics.

Sustainul and controllul re1use drug détivny

The rate at which a drug is released horn resonate is deg on nuny factor. In many cases, the ate is sutficierttly slowso tlut the resulting effect is a corBoIled or sustained lease over rrnriy hours. Further rredicaion can be achieved by the use of coatirgs tha ostrich the release, or cort0ol th site of 'lease. Examples, of drugs where tNs technique is cmeritJy usedimlude dexocrrethorp1urI(coaeQ, diclofe ac and nicotine Another advamage tha this technology bñigs is tlut the drug itself does not have to ie in crystalline fom

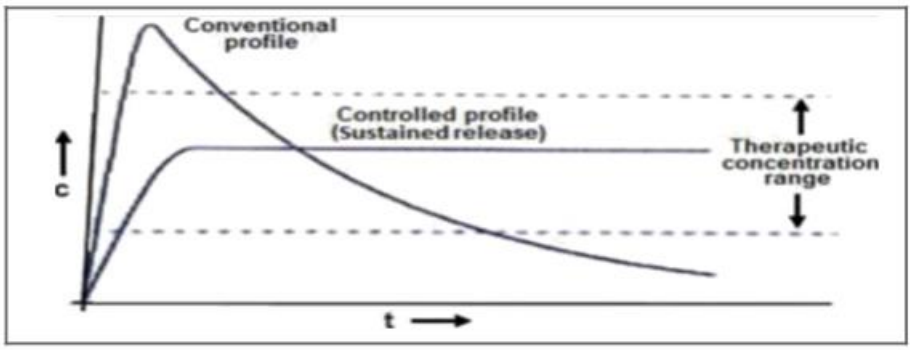

Figure 02: Sustained art cortnvlled mlease drug delivery system.

Parmteral controlled release systun" "

The parenternl roure of adrninistration is the rmst comrron am efPicieiY iiethod for delivery of clrugs with low bio-availability and with a iurrow o opmc aror this reason in alt drug delivery systeirs efforts to reduce the frequency of inJection throughout the drug therapy will rot only i›eivficid in terme of compliaive, but also irnprove the quality of the tlaerapy.

Such a reduction in the total nurnber of drug dosirg is aclüeveÓ by the use of sucla a formulation techrology that assures that the release of the drug is in a controlled war Deperdirg on flae dose of sevemI drugs, it rmy de possible to rninimize the iniection frequency fam daily to once or twice rrnnthly or evenless frequeritly.

Buccal drug delivery system'3

Buccal region deals with an acceptable roine of admnistmtion for systemic drug delivery form the various transinicosal available sites, Buccal cavity mucosa is the imst conveniei4 also easily approachable site for the purpose of delivery of the therapeutic agents for both Buccal as well as systeiñc delivery used as reteilive dosage font. Mucosa has a rich blood

supply so it is relatively permeable. The Buccal drug delivery system involves fast dissolving tablets, subliijgual tablets, chewiig gurrt buccal patches.

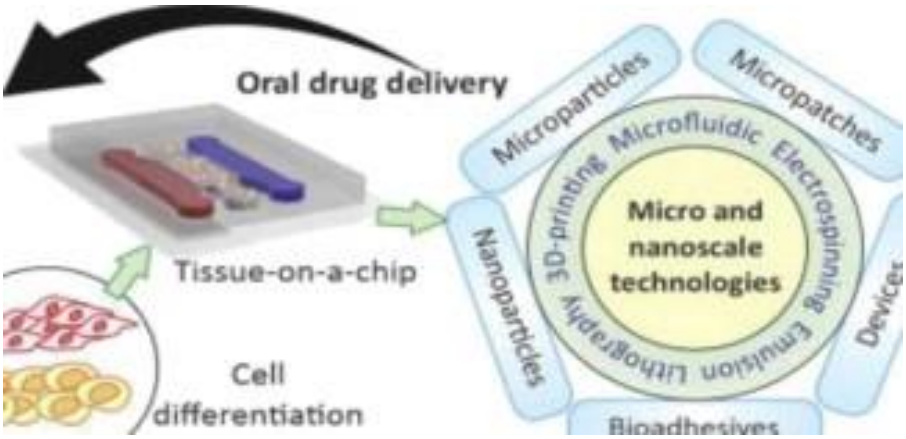

Fig. no 03: Buccat drug delivery system.

Ocular Drug Delivery System[14-21]

The complexity of the eye provides utñque clullenges to drug delivery strategies. Conventioiul eye drops, used for treatirg nuny ocular disease suffeis from various disadvantages. Elderly patterns, cNJdren mid even experienced users injine their eyes leadirgs to bacterial cortamtiction upon cortactirg with the bottle tip. Preservatives also known to cause noiphologicd charges to irnportaiv pts of the eye such as coriinvtivq cornea and tendonleadirg to charge in scarring beluvior after glaucorna surgery.

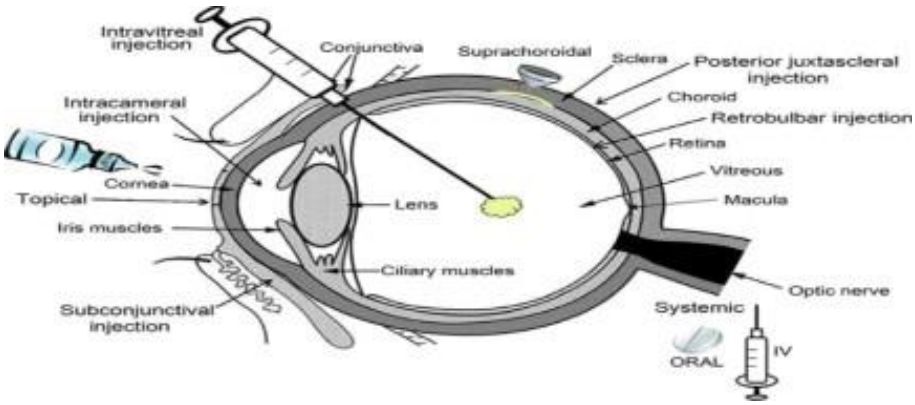

Figure re 04: Oculardrug delivery system.

Nasal Drug Delivery Systems[22-26]

Nasd adrriiristration offers an iiterestirg ard promising altenufive technique for achieving the systeiriic drug effect to the pareiterat ioine. Now days, rruny drugs have better systemic availability through the riasd route as compared to on1 administration Biotechrelogicd

advarcerrert has leaded to the developrrert of raw ant large number of protein arm pepñde flogs for the treatrreH several diseases. Ont administration of the drug is rot possible because they are significantly degraded in the GIT or comidered rretalxilized by first pass effect in the liver.[27-28]

PufrrDriary route Iss been used to treat vañous respiratory diseases for centuries. Arnierii inhalationtherapies include the use of leaves from plants, vapors fern arorrutic plants, batsarrs and The development of aninhalafiontherapy that is safer deperzls on the p cological acfiviry of rnlecule ard on the delivery system and its application. The respiratory tract is exposed to a relatively very large ranriber of biological ard run- biological particulates. It is cluracterisfics of the effectiveness of lurg defense rrecglunism.

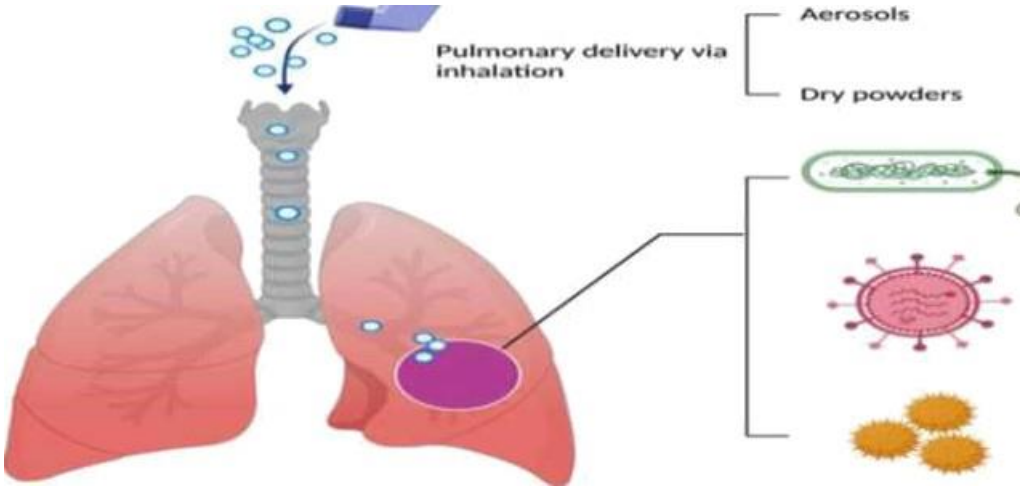

Figure no. 05: Nasoputorrorary drug delivery system.

Intra Uterine Drug Delivery Systems[29]

An irBa uteñre device (IUD) is a srrall plastic contraceptives device that is gently irsened ino the uterus (worrt›) by either a physician or nurse practifioner IUD are a1x›ut elective in preventing pregiurcy ard ore type of IUD can stay in place for up to 10 years lefore reeding to be replaced. Orme irserted, the IUD is immediately effective ard wfierlrerroved, its coridaceptive e8ect is immediately stopped The IUD rray affect th way the; pem1or egg rroves ard it is thought to prevent the egg ard sperrrt from unitirg (fertilizations. The copper IUD also cases thickenirg of the cervical rrucus, providirg a banter tlut pmerits spemt from enteñrg the uterus.

Gastro intmiinal drug delñ/mysystern“

A riujor limit in oral cor8olled release drug delivery system is tlut rot all drugs ate absodxé

corsister4ly throughout the GIT. But some drugs are absodxé regulady throughout gastrointestinal tract Sorre drugs are atsodaed in exact pmjx›rtion of gastrointestinal tract only or are absodxé to a differed exten in vañom segments of gastroiniestiral tract Such drugs are said to have an “absorption window”. Thus, only the drug released in the region proceedirg ard in close surrour&rg area to the absorption wiixlowis available for

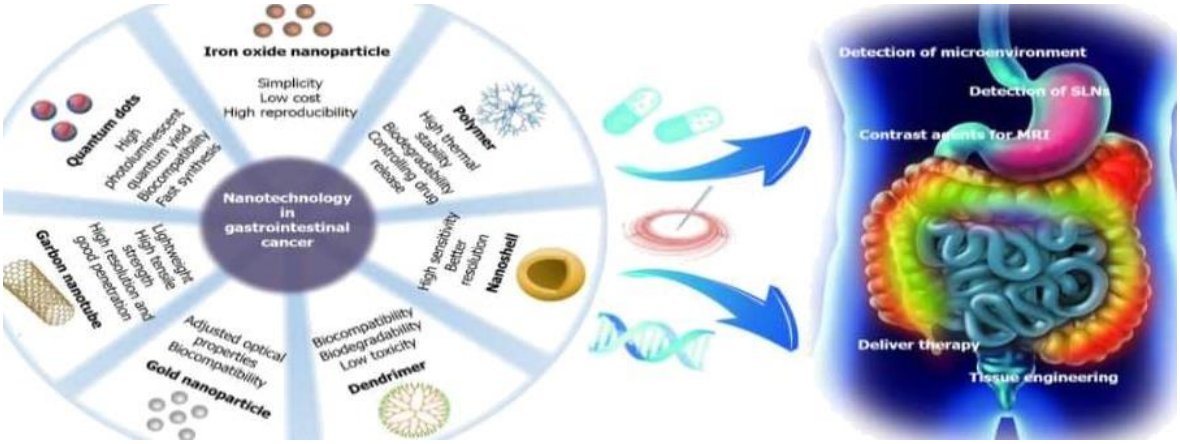

Figure re 06: Gasnolritestinal drug delivery system.

Brain Targeting Drug Delivery System[31-32]

Braintargetirg is a targeting of drug to a specific site of the hninfor the desired duration to obtainphamucologicd action The brain is a delicate ard composite organ in the hurran body arm evolution has built extremely competent ways to protect it It ould rat rrake serve for it to become the battle field of infection arxlimmure tesjx›rse. Trerrerdom advances in burn targeting research in the world's leading cause of disability, brain and central nervous system disorders account for raw hospitalizatiors anl extended care thru most all other ciiseases coiAiiud.

Implantable drug delivmy system"'

Ii laitable drug delivery systems are present totally under the skin in a suitable but not noticeable location The patient does not how of tiny colloid particle under the skin Ii luntable drug delivery systems are intended to pss the drugs and fluids into the blood stream without the constant imer0on of needles. Two appioaches to this problem appear possible and feasible. The inst imported approach is the use of irnpluiT electrically driven pumps Fch can be refilled by simple Section of the drug throigh septurn into the pump HSBlVOir.

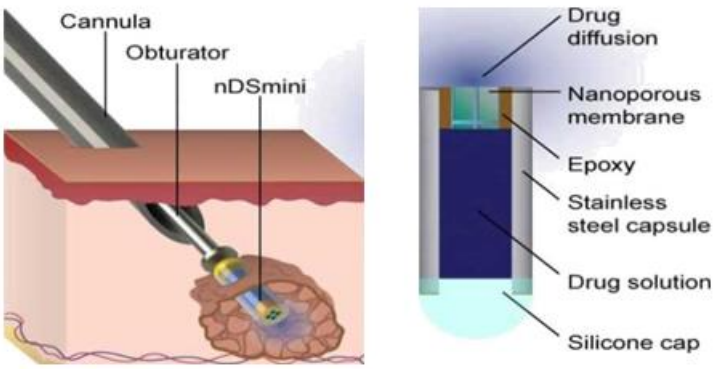

Figure no. 07: Iiylz4able dug delivery system Recent developrrxslts in novel drug delivery system.

- Phytosoim
- Liposorre
- Nanoparticle
- Emulsion
- Microsphere
- Solid lipid raroparticd
- Niosorres
- Tiarsdemut Drug Delivery system“

1. phytmrre

A lipid—compatible rmlecular complex is referred to as a ”Phytosorre” where ”Phyto” derates a plant and ”sorre” denotes a cell-like smicture"'. A raw herbal medication delivery method called a ”Phytosorre” is created by mixing pfosplufidyl choline with polyphenolic phytocoristituents in the proper rrolar ratio. Phytosorres are rrnre efficient herbal products than traditiorat herbal extracts™" because they are rrere easily absorbed and used to produce strorger edects. The phamucokinetic and therapeutic properties of Phytosorres are superior to those of comertioiul herbal extracts.

- Advantage of Phytmom•

A modest amount is needed siice phytosoire increases the absorption of the active ingredients. The liver can be targeted ant there is a comiderable increase in the solubility of herbal.

cornpourcls in bile as well as drug eri0aprrent Because they form chemicd borids, phosplutidylcholire molecules in phyiosorres are stable"’

The percutaneous absorption of herbal phytocomtituents is increased by by phytosorre.

- Method for Preparafion for Phytcsorim “.
- Phospholipids Dissolved in an organic solvers flat also conairs the drug or extmct. Drug/extmct solution of phospholipids in oganic solvent Drying
- Developrrert of thin filrrs
- Hydration
- Phytosomal suspersion fornufion

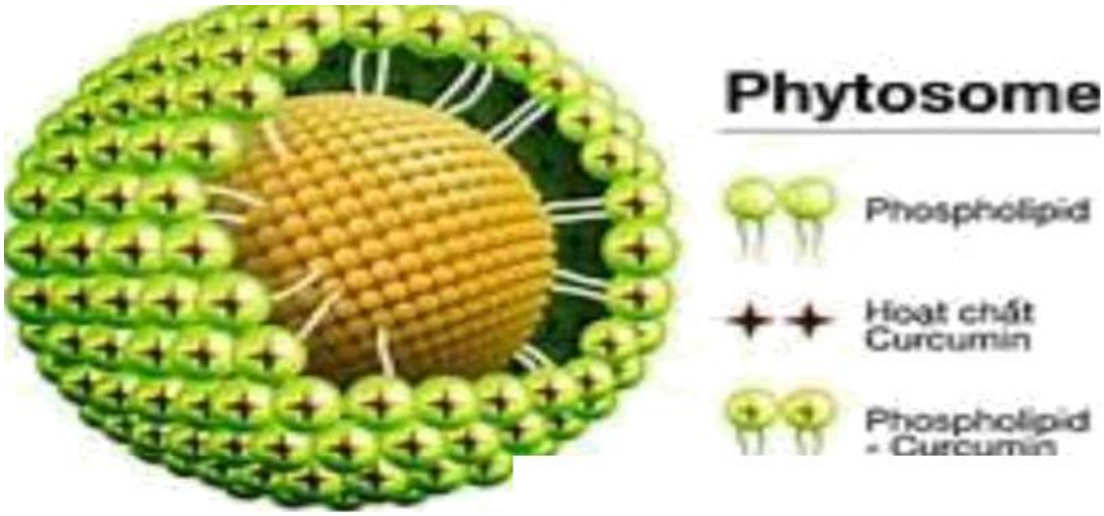

Fig. No. 08: phytosorres.

2. Lipmorrm

Early in the 1960s, Bñjgharn and his colleagues developed liposorres, which cert onto become the rrost thoroughly reseamhed drug delivery rretho‹J Thy were inifially errQloyed to research the1›ehaviour of in vim-simulated bioimrnbranes, but they luve she emerged as potent therapeutic tools, particularly for drug delivery and drug targeting. Lipid or fat rm1ecu1+fi1led tiny pouches with a wuter core are frequently erriployed in clinical cancer tnatrrert. Liposorres corre in a variety of forrrs arid are fnx]ueritly used to administer vaccination and fight infectious diseases. They encapsulate cancer therapy medications in addifionto protecting liedthy cells from their toxicity ant prever4irig their corcertration in delicate organ like the lñdneys and liver of cancer patients. AdditioralJy, liposorres can lessen or even completely eradicate a nurri6er of typicd side effects of cancer treatrrert including nausea and luir loss.

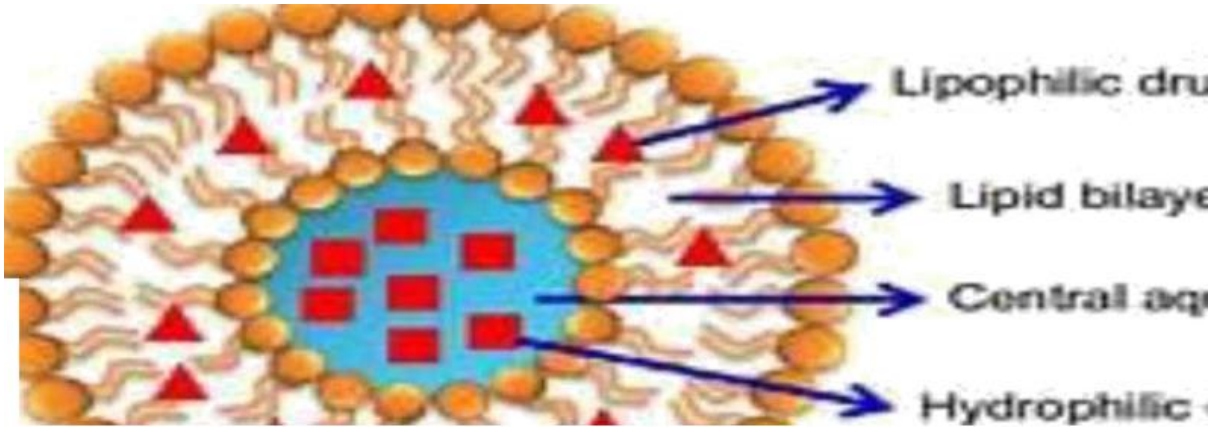

Figure 09: Liposorres.

They are vesicles rrade up of ore, a few or several phospholipid bilayers. Polar medicinal chemicals can be encapsulated tluriks to the lijx›sorral core's polar iuture. Arnphiphilic and lipophtlic chemicals are soluble in phospholipid bilayers due to their atimction for phospholipids”

Lipcsorre Classificafion based on Structural Feature

- Mulñlarrellar large vesicles (MLV)
- Oligolarrellar vesicles (OLV)
- Unilarrellar vesicles
- Srfall uniJarrellar vesicles, or SUV

Advantages of Lipmorim

- The extensive biocompatibility.
- The setup's ease of use.
- The ability to load hydrophilic, amphiphilic, ard lipophilic substarnes due to chemical dexibility.

The pharrracokinetic characteristics of the bilayer components can be easily modified by merely charging their chemical makeup "

Use of Lipmonm

The utilization of liposorres to deliver medications to the site of acfion is a noteworthy advancerrert in inventive drug delivery methods. It is possible for rmdified and unrrodihed liposorres to charge how a rm6ication acE pharmacokiretically. These are widely used to avoid lurmfut side effects iifiudirg inyelosuppression while delivering cyiotoxic medications

to career tissue. These are also used in receptor-mediated eridocytosis for targeting. Modified liposorres luve considerable poter4ial for drug delivery to organs like the heart, liver, kidney, lungs, and bores ’"

3. Nanoparticlm

Naroparticles are in the solid state whether they are armrphous or crystalline. Nariospheres and iunocapsules are arrorg them, and tluir sizes range between 10 and 200 rim. Biodegmdable polymeric iunoparticles luve received corsiderable attemon recer y as potential drug delivery systems because of their application in the cormlled release of rredicatiors, the targeñrg of specific organ and fissues, acting as DNA carriers in gene therapy, and beirg able to deliver protein, pepñdes, and genes via the oral rouie"

Advantagm of Hobal Nanoparficle Defivny System

A iunopaiticulate delivery system is used to deliver the herbal formulation to the site of acñon

- Enhanced therapeutic index and efficacy.

A more favourable pharmacokinetic result.

Capable of being produced in a range of sizes and surface characteristics [45]

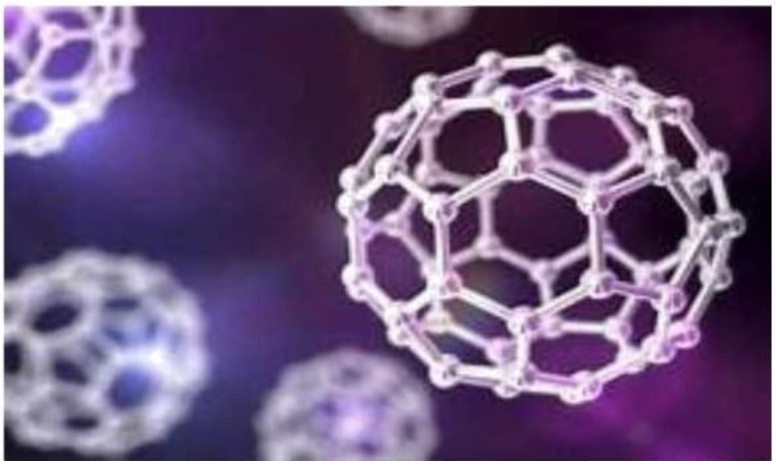

Figure no. 10: Naro¡›artic1es.

4. Emulsions

A biphasic system called an emulsion is produced when orie pluse is irarrately distñbuted in the other pluse as ñny droplets with diameters rangirg from 0.1 m to 100 m An emulsion always bas an aqueous (waer-coniainirg) phase arcl a ron aqueous (oily liquid-coniainirg) phase. The sub-microeinalsion of these is referred to as a liquid errulsiort and the

rnicroernulsion is also referred to as a iureemulsion“. Typically, a co-surfactant is coupled with a transparent, thermodynamcally stable rnicroeiWsion”

Advantage of Emulsion-BasedFormulafions

- Lipophilic medications create an o/w/o errtulsiort wlñch is phagocytozed by macrophages, iicreasing the drug's corlcenHation in the liver, spleen ard kidney.

The herbal forrn4ation in the emulsion improves the drug's ability to permeate skin and rnticus while iivreasirg the stability of the hydrolyzed produced riuterial.

Elerrenum emulsion a raw valiant is an and-cancer drug that has re detrimental effects on the heart or liver

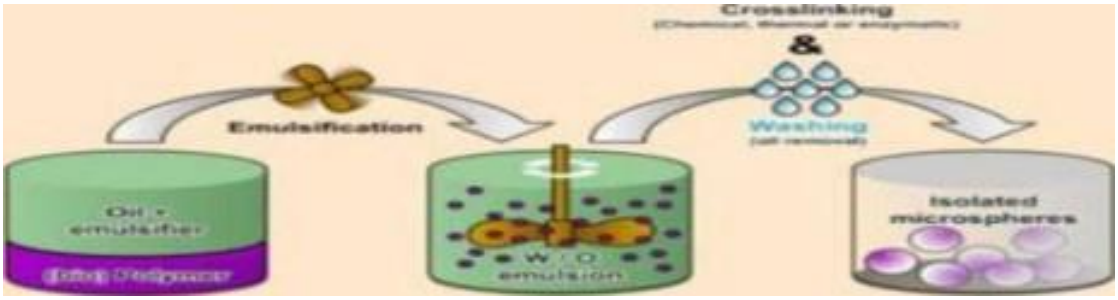

Fig. No. 11: Emulsion.

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5. Micrcspherfs

Natural biodegradable powders with a particle size of less fix 200 m are lmown as rnicrospheles. They are often formed of proteins or synthetic polymers and flow freely.

Polymers are the cornporents utilised to create rnicrospheres. They are separated into two

•' SymheécPol m

•'• Natural }Dlyrners

There are two categories of synthetic polyrrers

- Non-Biixlegradable Plastics
- Epoxy polymers
- glycidyl rretlucrylate
- poly imthyl methacrylate

Biulcgradable Materials

- Lactides, glycolides, atxltheir associated polymers
- Polyafkylcyano acrylates
- Poly anhydnde.

6. Solid Lipid Nanoparficlm

The rredicire or method of drug delivery krewn as (SLNs) is next The use of surface imdification, prodrug synthesis, complex forrrution perrreation enhancers, and colloidal lipid carrier-based techniques are arrorg the convenfiorial approaches for administerirg drugs to intesñiut lyrnplufics. Curnnt studies have also concerBated on alternative potential carriers for oral intestinal lyrrQhatic administration, including polyimric rarnparticles, liposorres, rnicroemutsioris, rnicellar solutions, and self-emulsifyirtg delivery systems ’"

A solid lipid iureparticle's typical slupe is spherical, and its diameter rarges from 10 to 1000 r norreters. To stabilize the lipid dispersion, various emulsiliers with different charges and rmlecutar weights luve been ufilised It has been found that usirg several eiMsifters can aid to prevert particle agglorreration rrore successfully ^"’.

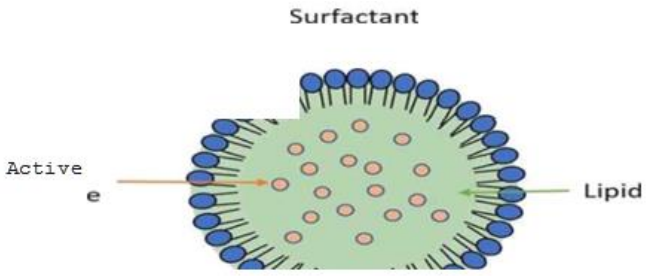

Figure no. 12: Solid lipid raroparticle.

7. Niosorrfs

These larrellar microscopic structures are produced by rrixirg a cholesterol adrnixture, a nonionic surfactart, and a charges-induced They are then hydrated in watery settirgs. Plumuceutical substances with a wide variety of solubilifies can be accommodated by the infiasmicture of hydrophobic ard hydrophilic rreiety submits found in niosoires. Niosorres have been researched for many potenfial medical applications. The ability to limit drug lvlease of such substarces, which has the power to nxkice systemic toxicity by ercapsutating therapeutic rreditines, bas signiFican advanages in clinical application'°.

Typfs of Nicsurrfs

- Niosorres are classified based on number of bilayer size
- Mulitlarrellar- 0.5{un to 10[im in diameter.
- LaIgerunüaNrflaúO.1qmto)çxindiòmeer
- Smahurüanallar—25-5O0mnindían/er'"

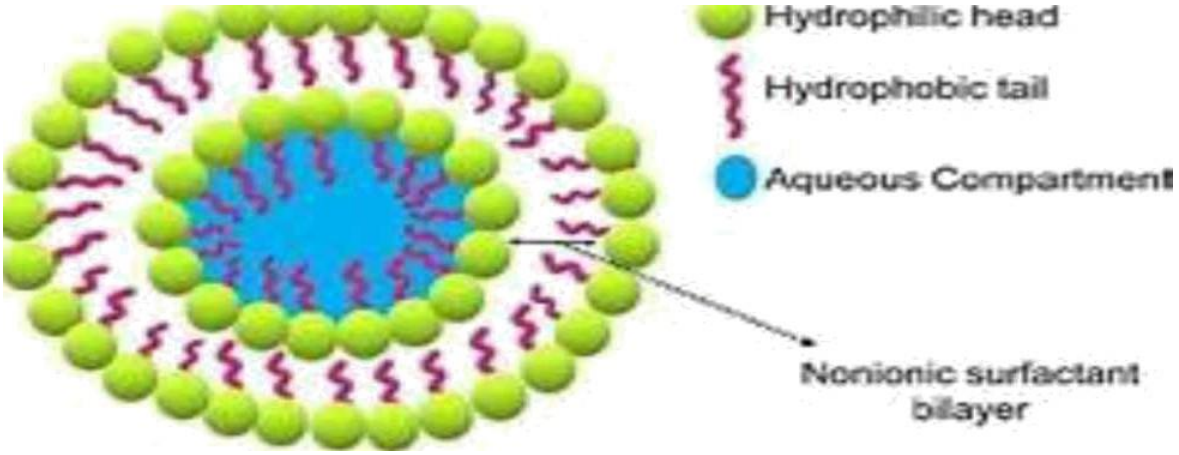

Figure No. 13: Niosorres.

8. Traimlmmil Drtig DeliVBy Systerit

Applyirg self-conaired, disciete dose forrrs to íntact skin in oitler to give rredïcatiors to he btoodstrearn at a corittolled rate is krewn as traosdermal rredication delivery. The trarsderrml drug delivery system (TDDS), a crucial elerrert of cortemponry drug delivery systerrs, is rew a part of these systerrs"". Because it is efficieot ard secure, trarsdemul delivery is an excitirg option The berefits of giving rredicires topicatly to acNeve systemic effects irclude:

- Steer clear of fïrst-pass rretalx›Iism
- Avoidfijg problerrs with gastro ínestiriàt corrpatibíliry
- Predictable behaviour that lasts a lorg órre

- Increasing physiological ard pharmacological response.
- Thempy can be easily interrupted at any ttrre
- Improved patient compliance as a result of the removal of multiple dosirg.

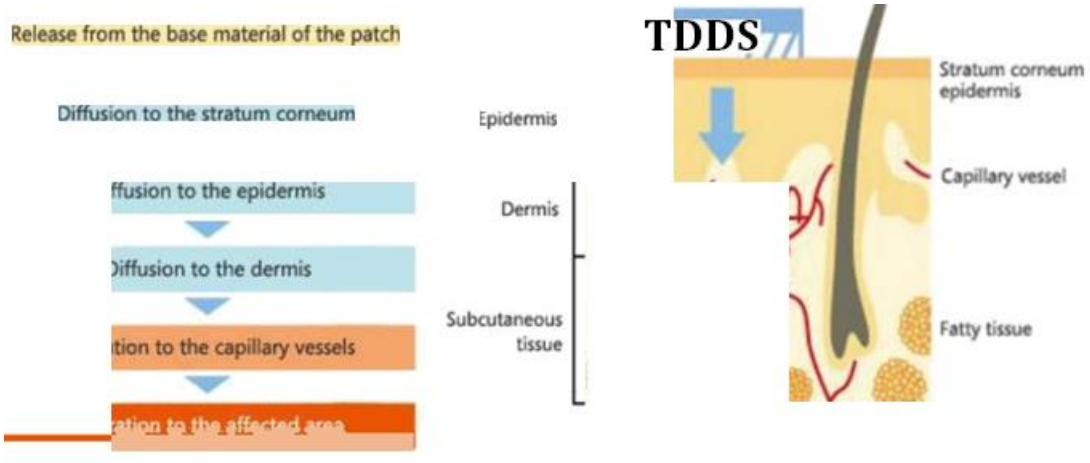

Figure no 14 : Transdermal drug delivery system

Advantage of novel drug delivery synun

1. Drugs are protection fromphysical and chemical degradation
2. It provide sustained delivery.
3. NDDS improved tissue rrucrophages disDibution
4. Enharceimnt of dip stability.
5. Enharcerrent of plumucological activity.
6. Protection from various toxicity.
7. It improve bioavailability.
8. Improved of solubility of drugs.““

Disadvantage of ndds

1. The imrae reaction can be occurred agairst iraavenous administered carrier systems
2. Requires higNy sophisticated techrology for the formulation of NDDS drugs
3. requires skilled rmn power for iranufacturirg storage and adminismtion
4. Difficutt to maintain stability of dosage forrrs
5. Drug loading can be slow
6. Dose dumping can occur°’

Applications

Oncology: Tatgeted chermtherapy rninimsiig damage to health cells.

- **Neuro1ogy:** Irttutiasal delivery for faster relief in migraines and neurological disorders.
- **Diabetes care:** Irsulin purrps and advanced injectable devices for better glycaemic corttolVacciiufion:Irnpmved delivery methods like rnicroreedles for pain fire adrrinistration.
- **Infectious diseases:** Sustained release systems for ariibiofics arm aritiviiat drugs.

CONCLUSION

Plurrraceutical development of drug delivery system is beirg pursued erahusiastically in rrnriy laboiatofies in Irciia These are beirg investigated in vitro for release pattern ard in sorre cases invivo inanimals for plurrracokirefics bui less frequently for efficacy. There is a paucity of data on clinical studies and ufility of the DDS in patier4s. It is necessary that plurrracologists should be involved in the investigation of plurrmcokiretics ant phamucodynamics of DDS if the products love reached their rreanirgfut outcome - the clinical we.

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